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Beyond "Do neighbourhoods matter?"

Investigating heterogeneous neighbourhood effects on youth development

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Introduction

In 2019, the United Kingdom's Conservative Party first announced the flagship "Levelling Up" policy, with the ambition to reduce imbalances between areas and social groups and transform the country by spreading opportunity and prosperity to all parts of it.

A merit of this policy proposal has been to formally recognise that not all places are the same and that these places, their social and structural characteristics, matter to people. Geographic location, and the neighbourhood of residence in particular, represent indeed a major contextual determinant of individual opportunities and achievement. The family environment is a critical dimension for youth development. However, the literature has also highlighted how the transmission of particular traits, including educational advantage, is the outcome of processes happening not only inside, but also outside, the family (Cavalli-Sforza and Feldman, 1981; Bisin and Verdier, 2011). Children become educated via parental raising but also via socialization processes taking place outside the household, such as in the school they attend or the area where they live in, if these are sufficiently high quality in terms of human capital and resources (Patacchini and Zenou, 2011).

In light of this, this thesis focuses on the effect of the characteristics of the residential neighbourhood on youth development in the United Kingdom (UK). I draw on the National Child Development Study (NCDS), an ongoing cohort study which includes 17,415 individuals all born in the same week in 1958 and who have been interviewed at different stages of their life. I focus in particular on cognitive and non-cognitive skills, as it is well-known that the development of these skills and abilities is important not only for educational outcomes, but also overall life-course attainment (Cunha and Heckman, 2007; Blair and Razza, 2007; Duckworth and Seligman, 2005; Duncan et al., 2011; Valiente et al., 2010; Lleras, 2008).

Understanding the influence of the local area on youth cognitive and non-cognitive abilities is particularly important in light of the *education-based meritocracy* ideology (Bukodi et al., 2016; Goldthorpe and Jackson, 2006; Barone, 2019; Saunders, 1996, 1997), which has been embedded into politics and the broader public discourse since the post-World War. Such a political manifesto stresses how individuals can progress and scale up the social ladder only by virtue of their merits, i.e. if able and motivated enough, and regardless of their own social background. Among all countries, the UK has represented a hotbed for research and practice around this topic. From the renown first Nuffield social mobility studies (Goldthorpe, 1980) which have been a benchmark in British social science, to the controversial studies carried out

by Saunders (1996, 1997) and all following analyses (see, for example, Savage and Egerton, 1997), scholars have frequently focused on this setting to assess the relative determinants of educational and life attainment, debating the extent to which these are driven mostly by individual ability vs. socially influenced.

Such a meritocratic approach is nowadays more than ever present within our daily life and conversations. For example, in a recent poll probing public opinions as for how the "Levelling Up" agenda could improve local areas with regard to the educational context, public responses were rooted in the importance of fair play and the belief in the value of personal responsibility (Schwitzer and Lister, 2021). Most respondents backed indeed meritocracy-based measures such as increasing available apprenticeships, funding for work placements and for people to retrain later in life, discarding initiatives aimed at favouring specifically disadvantaged populations such as lower entry requirements for students from disadvantaged backgrounds and limiting the number of places available to private schools (Public First, 2021). Among the weaknesses of such meritocratic ideal is the risk of masking that skills development and education tend to be socially determined, as emphasised by many sociological theories, not only in the neighbourhood field (Bourdieu and Passeron, 1990; Lamont and Lareau, 1988; Lareau, 2011). Under this view, the UK is an interesting context. Spatial inequalities exacerbated since the 1970s, with severe consequences on the different opportunities available to the population, and overall resulting in the UK representing the most spatially unequal country within the industrialized world, as highlighted by a debated 2020 article published by The Economist. Nonetheless, the UK is not unique in its situation. Geographic inequalities have been on the rise in all European countries in the past years (European Commission, 2023), which makes a thorough analysis of this case important for understanding the broader societal implications of such disparities as well as their effects over citizens' life.

Neighbourhoods represent indeed the fine-grained context in which individuals grow up and interact on a daily basis, influencing individuals' development, and thus, their life trajectories over time (Sampson et al., 2002; Sampson, 2012). With their community contexts and social networks, they constitute meso-level social structures able to influence one's own skills, attitudes and behaviours. In a parallel with the relational inequality theory (Tomaskovic-Devey and Dustin Avent-Holt, 2019), neighbourhoods can thus be understood as "organizations", involved in the processes of access and distribution to resources as well as of routined inter-relations. The socioeconomic composition of the residential area determines the differential opportunity structures available for youth to develop, via multiple pathways such as patterns of socialization, mechanisms of collective efficacy and the level of institutional

quality (Jencks and Mayer, 1990; Leventhal and Brooks-Gunn, 2000; Raudenbush and Sampson, 1999). Overall, it is the combination of these dimensions that marks a person's experience and their vantage point on the social world (Mijs and Nieuwenhuis, 2022) and that has been found to significantly influence youth skills' development.

Notwithstanding the relevance that neighbourhoods play in influencing youth development, within the literature that focuses on neighbourhoods it has been rarely acknowledged that there is not a "*one size fits all*" for area-related effects. Quantitative studies have flourished since the second half of the 20th century, trying to assess the influence played by a variety of neighbourhood characteristics, such as neighbourhood poverty, poor educational climate, social disorder or social control (Sampson et al., 2002; Nieuwenhuis and Hooimeijer, 2016) on important life outcomes. The majority of these works has suggested that less/more disadvantaged residential environments positively/negatively affect youth development and future prospects (Galster, 2012), consistently showing that neighbourhoods are important. However, the underlying logic based on which the residential context affects development and life course patterns is still unclear. Authors have indeed stressed that the literature needs to move away from responding the question "*do neighbourhoods matter?"*, which has represented the core of research efforts in the past few decades. Rather, authors should focus on exploring the heterogeneity of neighbourhood effects, trying to better understand the specific conditions under which neighbourhood effects may take place and the related underlying mechanisms (Sharkey and Faber, 2014). A broad criticism indeed, whose origins date back to Jencks and Mayer (1990)'s first comprehensive review of neighbourhood effects and whose main argument is that neighbourhood research is a "black-box", still appears relevant today (Galster, 2012; Van Ham and Manley, 2012).

With these issues in mind, a first point to which I warrant attention is the diversity of the outcomes studied within the neighbourhood literature. Scholars have typically focused on a set of outcomes that include cognitive skills and educational achievement, employment, physical and mental health, as well as residential outcomes later in life (Brooks-Gunn et al., 1993; Chauvin and Parizot, 2009; Mayer and Jencks 1989; Sampson et al. 2008; Sampson 2012; Sharkey and Farber 2014). In contrast, individuals' non-cognitive skills have attracted far less attention. Non-cognitive skills are also sometimes referred to as "socio-emotional skills", "soft skills", "like skills" or "character skills" and they refer to capacities that enable individuals to deal effectively with the demands and challenges of everyday life (WHO, 2001). Neighbourhood scholars have typically analysed individuals' non-cognitive dimensions very broadly conceptualised, focusing for example on teenage pregnancy, substance use, violence,

stress or measures of behaviour and (mis)conduct (Sampson et al., 2002). In contrast, studies considering proactive indicators of non-cognitive skills, which are also more strictly related to school and work (Bowles and Gintis, 1976), are still missing from the sociological literature.

Looking into how neighbourhood conditions influence the development of non-cognitive skills is, however, important for many reasons. The literature tells us that they are predictors of relevant outcomes in both childhood and adulthood, *in primis* academic performance and educational attainment (Taylor et al., 2017; Giofré et al., 2017; van Poorvliet, 2021), but also health (Carter et al., 2019), social mobility (Esping-Andersen and Cimentada, 2018; McGue et al., 2020), employment and occupational outcomes (Carneiro et al., 2007; Jackson, 2006). Since the 1960s, when sociologists in Wisconsin found that aspiration was an important explanation of why children from higher SES families would achieve higher social status when they grew up (Sewell et al., 1969; Liu, 2019), research has investigated the social benefits of higher non-cognitive abilities. Moreover, non-cognitive skills are at the core of currently dominating education-based meritocracy ideology and, relatedly, are the object of many policy programs and debates. As an example, in 2010, Nick Clegg, the UK deputy Prime Minister recited: "'*Fairness demands that what counts is not the school you went to or the jobs your parents did, but your ability and your ambition. In other words, fairness means social mobility*' (Clegg, 2010). Ambition emerges from this discourse as a (non-cognitive) trait as important as ability for overall individual success. Following this political mindset, policy initiatives aimed at enhancing and fostering non-cognitive skills have flourished in the US and elsewhere, such as the OneGoal (Kautz and Zanoni, 2014) or the EPIS (Martins, 2017) programs. Overall, it seems like considering how neighbourhoods influence a varied range of non-cognitive skills, in addition to cognitive skills, from the early life course can be both important to understand individuals' trajectories, as well as inequalities in achievement.

Considering all this, with this thesis I aim to contribute theoretically, empirically as well as methodologically to neighbourhood effects research.

From a theoretical perspective, this dissertation builds upon the need to recognize and take into account that neighbourhoods are not a static feature of individuals' lives, experienced in a uniform manner by everyone within it (Lupton, 2003). Rather, as also stressed by Harding et al. (2010), young adolescents who live in similar neighbourhoods may experience them in very different ways depending on their own individual and contextual conditions. This creates some heterogeneous effects which need to be more thoroughly subject to scrutiny. Critically, understanding more of the heterogeneity in neighbourhood effects can also help to better

understand the processes through which neighbourhoods contribute to the production and re-production of social and education inequalities (Jackson et al., 2009).

Hence, I argue for the need to shed additional light on the interplay between individual and neighbourhood conditions, as this would greatly help in outlining the role of neighbourhoods in contributing to persistence in social inequalities. As highlighted by Small (2004, p.176), researchers should indeed *"use heterogeneity in responses to neighbourhood poverty as the starting point rather than [something] to ignore"*. Levy (2019, 2021) has recently tried to address such a challenge by developing four hypotheses of neighbourhood effect heterogeneity, based on the overlap between conditions of neighbourhood advantage or disadvantage and other individual or contextual forms of social advantage and disadvantage. Nonetheless, to date there are very few examples of empirical research that are grounded in such theoretical outlook. Moreover, under this perspective, family socio-economic status is the unique individual dimension that has been explored in combination with neighbourhood characteristics (Levy, 2019; Levy et al., 2019; Crowder and South, 2003; Wodtke et al., 2016; Ananat et al., 2021). In order not to under-theorise heterogeneity in neighbourhood effects, it is critical to expand upon these works. Thus, the empirical chapters of this thesis are carried out with this objective in mind.

First, it is important to re-consider those individual characteristics, such as age, gender and ethnicity, which have been extensively analysed within neighbourhood research, but for which evidence has often been inconclusive. In the first empirical chapter, I review and re-assess the role played by neighbourhood disadvantage on a rich set of cognitive and non-cognitive outcomes and, crucially, how this varies by gender. Many quantitative and qualitative works in the neighbourhood field have focused on this individual dimension finding, overall, that males and females tend to be differently affected by their residential environment. However, explanations have been mixed and it is difficult to reconcile predictions available from the literature. One consideration that might have influenced up to date explanations over gendered neighbourhood effects is that, as for the more generalised neighbourhood literature, there are no empirical accounts that go beyond problematic behaviour and focus instead on how the neighbourhood environment might affect boys' and girls' *positive* non-cognitive skills development. I argue that focusing also on such aspects, in addition to cognitive skills and more renown dimensions of problem behaviour, can help to disentangle the mechanisms through which neighbourhood deprivation is found to exert different effects for male and female youth.

Second, the neighbourhood literature would benefit from a better integration of the role of time within the field and, more broadly, the adoption of a life course perspective (Van Ham et al., 2016). We are increasingly aware that life histories and even beyond, i.e. multigenerational trajectories, critically affect the persistence of advantage and disadvantage over time (Mare, 2011). Hence, neighbourhoods should be conceived as a multi-generational, longer-term, developmental contexts in order to understand the full scope of how and when they matter for inequality (Sharkey and Elwert, 2010, 2011; Alvarado and Cooperstock, 2021; Crowder and South 2011; Quillian, 2003). In the second empirical chapter, I analyse the extent to which multigenerational exposure to neighbourhood conditions of disadvantage affects cognitive skills and socio-emotional behaviour in the early life course. On the one hand, I estimate the independent and cumulative effect of two consecutive neighbourhood environments on youth development. Research suggests that deprivation at the neighbourhood level experienced not only in the same generation in which the individuals are growing up, but also in the previous generation, has indeed the potential to exert a lingering effect over time (Sharkey, 2010, 2011). On the other hand, I pay particular attention to how neighbourhood trajectories experienced over two generations affect individual outcomes. Plenty of research has focused on social mobility trajectories, estimating the effect of moving up and down the social ladder between different generations within a family (Pfeffer, 2014). I focus here on the relatively understudied dimension of spatial mobility, estimating the differential impact of stable, upward and downward trajectories of neighbourhood disadvantage across two generations.

Finally, for the field to move forward, we should incorporate within neighbourhood research relatively new and understudied individual characteristics, going even beyond the boundaries of sociology. Sharkey and Faber (2014) emphasise in particular the need to incorporate new theories of how individuals respond to their environments in ways that vary based on individual susceptibility. In the third empirical chapter, I study the interplay between individual genetic predispositions for education and neighbourhood environment on cognitive, non-cognitive and educational outcomes. To do so, I draw on major theoretical frameworks in sociology of education and social stratification, such as the cultural capital approach (Bourdieu and Passeron, 1990; Lamont and Lareau, 1988; Lareau, 2011) and the compensatory advantage model (Bernardi, 2014); as well as on hypotheses developed in behaviour genetics (Shanahan and Hofer, 2005), namely the Scarr-Rowe and the compensation models; and, of course, on broad theories on neighbourhood effects. Genes have been found to be important predictors of educational outcomes (Branigan et al., 2013; Silventoinen et al., 2020; Polderman et al., 2015)

and studies in behaviour genetics have emphasised that individuals tend to respond differently to the same type of environmental stimulus based on their genome (Ritz et al., 2017). However, only recently sociologists have started to integrate genetics into studies on the intergenerational transmission of socio-economic status (Liu, 2018). An established research tradition considers the interaction of genes and family socioeconomic contexts, typically finding that being embedded in a more advantaged family positively enhances the effect of genes on cognitive and educational outcomes (Baier and Lang, 2019; Erola et al., 2021; Figlio et al., 2017; Guo and Stearns, 2002; Lin, 2020). Inevitably, a question arises: if the family context is that important to shape the effect of genes on education, what about the neighbourhood context? Do neighbourhood conditions affect the influence of genetic predispositions on different education-related outcomes? And, more broadly, does the neighbourhood context amplify, or rather reduce, pre-existing educational inequalities driven by genetic endowment? To answer these questions, I perform the first analysis of its kind that tests the effects of the interaction between genes and neighbourhood environment on a comprehensive set of education-related measures.

From a methodological point of view, by exploiting the rich nature of the NCDS data, I am able to contribute to the relatively narrow literature which provides *robust* evidence about the heterogeneous effect of the residential context. The NCDS survey collects information on a variety of domains, from skills development, to educational and family background, to economic circumstances and family life. Building on these sources, my analysis is grounded in an innovative multidimensional approach to the effect of the neighbourhood environment. This thesis will exploit in particular information about place of residence (Patacchini and Zenou, 2011), cognitive and non-cognitive skills (Carneiro et al., 2007; Joshi, 2014) and genetic endowment (Davies et al., 2015). Neighbourhood characteristics are retrieved by matching the individual geographical identifiers available through the NCDS with information about area deprivation available from the UK census (Patias et al., 2021). In addition to that, I dedicate particular attention to the methodological challenges that have characterised neighbourhood research. The great majority of work around neighbourhood effects has been plagued by the issue of neighbourhood selection, namely the fact that individuals choose where to live, confounding the role of the neighbourhood with endogenous family characteristics. Typically, authors have tried to mitigate this concern by controlling for a wide range of individual and contextual characteristics. However, this is often not enough to make sure estimates are unbiased and to overall obtain robust evidence on the effect of the residential context, especially in longitudinal settings (Leventhal and Dupéré, 2019).

My empirical strategy is developed with the objective of obtaining robust findings. To do so I adopt different methods. In two of the empirical chapters, I am able to reduce endogeneity concerns by exploiting the allocation procedure of social housing units. This mechanism has indeed the advantage of providing a residential quasi-randomisation, by relying on a time-based allocation criterion and spreading beneficiaries among different neighbourhoods within each local authority. Other authors have used a similar approach to obtain quasi-experimental estimates of neighbourhood effects (Galster and Santiago, 2017; Weinhardt, 2010; Patacchini and Zeanou, 2011; Fumagalli and Fumagalli, 2019; Propper et al., 2007; Algan et al., 2016; Sari, 2012; Goux and Maurin, 2007). In the remaining chapter, I perform the main analysis by adopting, in combination with conventional OLS techniques, a relatively newer empirical strategy defined as regression-with-residuals approach (Wodtke, 2018; Wodtke and Almirall, 2017; Wodtke et al., 2020; Zhou and Wodtke ,2019). This method has been previously applied in the context of longitudinal neighbourhood research (Levy, et al., 2019; Wodtke et al., 2016) since it has the advantage of solving issues related to exposure-induced confounders.

Overall, this work contributes to the literature on spatial inequalities and social stratification from a specific angle. Neighbourhood disadvantage implies a series of limits and constraints on individuals. Investigating the spatial conditions that allow individuals to develop their skills and, consequently, increase their social opportunities across their life span is, therefore, key to understanding more broadly the extent to which social stratification and socio-economic inequalities within the neighbourhood operate and, possibly, could be reduced, across time.

The remaining chapters are organised as follows. The first part of Chapter 1 presents the main theoretical models of the neighbourhood literature, details the main outcomes of interest of the thesis (cognitive skills, non-cognitive skills and academic achievement) and provides a brief review of existing neighbourhood findings on these outcomes. In the second part, I build upon the need to further explore the heterogeneity in neighbourhood effects. I briefly present a recent relevant theoretical framework (Levy, 2019, 2021) and discuss how I expand on it within this work. Chapter 2 introduces the context, the data and then reviews methodological challenges and approaches typical of neighbourhood studies. I also provide further explanations over part of my empirical strategy, which is the exploitation of the social housing allocation procedure in the UK. Chapters 3, 4 and 5 are the empirical core of the dissertation. Chapter 3 analyses gendered neighbourhood effects. Chapter 4 is concerned with neighbourhood effects across two generations. In Chapter 5, the focus is placed at the

intersection between neighbourhood environments and genetic predispositions. Finally, the conclusion summarises the main findings, while expanding briefly on their implications for neighbourhood theories, as well as educational and social inequalities. I finish by evoking some policy implications, broader limitations as well as avenues for future research.

Chapter 1

A comprehensive perspective on neighbourhood disadvantage and education-related outcomes

While a variety of channels exist that can affect individual development over time, such as the family, school or the relationship with parents (Boudon, 1974; Bourdieu 1977; Heckman 2006; Lareau 2003), I focus on the role of one particular meso-level social structure, the residential neighbourhood, which is the main topic of this thesis. In this chapter, I first present a number of theoretical perspectives which describe the pathways through which the neighbourhood environment might exert its effect on youth development. In a second step, I briefly discuss the outcomes relevant to this thesis: cognitive skills, non-cognitive skills and academic achievement. I then review the current empirical literature that has investigated neighbourhood effects in the context of these outcomes and more specifically in the UK. I move on to discuss some of the recent criticisms characterising the neighbourhood field, emphasising in particular the repeated calls for a greater assessment of neighbourhood effect heterogeneity. Under this view, I build upon a recent theoretical framework (Levy, 2019), that provides interesting insights for how we think about heterogeneous as well as long-lasting neighbourhood effects, to highlight the contributions of the empirical chapters of this thesis and their positioning into the broader theoretical picture.

1.1. Theoretical perspectives on neighbourhood disadvantage

Traditional neighbourhood effect literature conceives neighbourhoods not only as geographical spaces, but also as social spaces. Research has highlighted the role of neighbourhood poverty and socio-economic status, evidencing how growing up in more disadvantaged areas, thus characterised by stronger constraints, seems to bear on individuals' life experiences and life chances (Friedrichs et al., 2003). Socio-economic and racial residential segregation (Safi, 2009) and school segregation (Oberti and Savina, 2019) have been the subject of much research to date. Repeatedly, it's been shown that neighbourhood-level spatial (dis)advantage implies a series of limits and constraints, as well as opportunities, for individuals, hindering or fostering their ability to develop skills and education and occupational outcomes and, thus, to improve their socio-economic condition (Sharkey and Faber, 2014; Jencks and Mayer, 1990).

Various underlying mechanisms have been considered with regard to the origin and unfolding of neighbourhood effects. A number of authors have systematically reviewed such mechanisms. In one of the first comprehensive works on this topic, Jencks & Mayer (1990) present a taxonomy of theoretical models. They distinguish between epidemic, competition, collective socialisation, institutional, and relative deprivation models. Galster (2012) lists four

main dimensions and 15 sub-dimensions that summarise the mechanisms through which neighbourhood effects unfold. These pertain to social-interactive, institutional, geographical and environmental dynamics. Overall, some of them are about individuals' interaction with their peers within their neighbourhood, while others relate to the residential area's structural, environmental and architectural characteristics.

In the analysis of the mechanisms behind neighbourhood effects, a first one to consider is the role of socialisation. Individuals socialise with others and develop through these interactions. In particular, research has highlighted how social behaviour tends to be learned through conditioning and imitation of other's behaviour (Akers et al., 1979). Thus, the neighbourhood can influence individuals' development, especially during the early life stage, through mechanisms of socialisation with people residing in the same residential areas. The process of socialisation with peers plays a significant role on individuals' development, in particular, during adolescence, when people start interacting less with their family and more with peers. Peers be act as a relevant influence on cognitive and non-cognitive outcomes (Crane, 1991; Gibbons et al., 2013; List et al., 2020). Jencks and Mayer's (1990) epidemic model predicts, for example, that negative peer influence results in greater problem behaviour. Empirical studies looking at crime and delinquent behaviours have shown that having delinquent friends and peers within the neighbourhood increases people's own risk of offending (Nieuwenhuis et al., 2015; Rokven et al., 2017). Wilson (1987) discusses in this respect the concept of social isolation from main institutions, which may lead to the development of "ghetto-specific" cultural repertoires or other forms of oppositional and confrontational cultures ruling within the neighbourhood.

A related mechanism is the presence of adult individuals or peers perceived (or not) as role models, which Jencks and Mayer (1990) define as collective socialisation. The presence or absence of adult role models within the surrounding environment who are positive examples to whom children can choose to aspire and emulate is in fact very relevant for youth, with respect to outcomes related to both education and behaviour (Ryabov, 2020). The role models valued in the context of the "ghetto-specific" or confrontational cultures (Wilson, 1987) often encourage the devaluing of formal schooling and value, on the contrary, risky behaviours leading in the end to poor educational and occupational outcomes. Qualitative findings from the US (Anderson, 1999) provide indeed evidence for a critical role played by older peers within the neighbourhood environment. These are often a selected group of people, who have not moved on to higher studies or employment, and which up acting as role models for younger youth within the neighbourhood environment. This contributes to the "ghetto story" and

influences young people's ability to break the chain of poverty. On an aggregate dimension, the level of unemployment within a neighbourhood will lead youth in that local environment to adopt lower commitment to work and, thus, might lead them to become also unemployed.

The accumulation of social capital (Coleman, 1988), meant as the network of social relationships available at neighbourhood level, has also been widely discussed as a mechanism affecting individuals' in various ways. Sampson et al. (2002) list various dimensions of neighbourhood social capital that matter, such as the level or density of social ties between neighbours (Elliott et al. 1996), the frequency of social interaction among neighbours (Bellair 1997), and patterns of neighbouring (Warner & Rountree 1997). The outcomes that social capital may affect are multiple, ranging from employment to health and life satisfaction. Looking at the former, for example, in socio-economically advantaged neighbourhoods social ties and interactions may allow adults to share inside knowledge about colleges and high-status careers. Such rich networks, instead, tend to lack in disadvantaged neighbourhoods. Also, a high frequency of social contacts or closer relationships within the residential area could provide individuals with a greater sense of belonging or increase their self-esteem and psychological well-being, thus often improving self-reported life satisfaction or health. Small's studies (2002, 2004) of social capital in a Boston barrio show indeed that in an effort to protect their community from urban renewal, individuals developed strong social ties that they used to create a wealth of neighbourhood institutions even though it is income poor. Other qualitative investigations in different contexts have confirmed how residents in high-poverty areas often have strong ties within small circles of friends and family (Quane et al., 2002; Dominguez and Watkins, 2003). While such close knit-relationships might contribute to positively shape residents' daily lives, authors have also stressed how sometimes heavy reliance on personal networks interferes with the development of networks able to produce social leverage and those resources that help vulnerable individuals get ahead (Dominguez and Watkins, 2003).

Another mechanism which has been deeply explored in the context of the residential area evolves around collective control (Sampson, 2012; Sampson et al., 1999). This considers how structural disadvantage and community social organization shape norms of behaviour, trust, social capital and everyday patterns of life. More deprived neighbourhoods are characterised by lower collective efficacy, which is the community-level capacity to mobilise on behalf of shared goals. In these neighbourhoods, individuals tend to be less cohese and thus less likely also to actively intervene and shape or clarify the rules that would be needed to encourage positive outcomes for individuals (Sampson et al., 2002; Kubrin and Weitzer, 2003). In practice, this often results in reduced monitoring over young generations and thus a lack of

discouragement in adapting anti-social behaviours, affecting outcomes such as higher truancy or earlier timing of the first sexual intercourse (Sampson and Wilson, 1995; Browning et al., 2005). Furthermore, lower collective efficacy corresponds to lower collective trust and higher crime rate, which negatively affect a variety of children's outcomes such as cognitive performance (Sharkey and Elwert, 2011), educational attainment and increases to teenage pregnancies (Harding, 2003). In addition, a lack of collective control and more broadly of clear normative rules within the neighbourhood can result in increased tension and conflict among groups of residents, which might result in lower individual outcomes. Venkatesh (2000) shows for example how, within poorer areas, an informal system of order not only exacts a cost in terms of gang violence and the drug economy, but also creates deep division within the community over the extent to which gangs could be perceived as potential contributors to community improvement.

Finally, researchers have also highlighted the relative deprivation hypothesis, which stresses instead how individuals suffer from engaging in social comparisons with a reference group (Marx, 1933; Runciman, 1966). This mechanism has, for example, been explored at school level, whereas a student's academic rank relative to other students strongly influences their ability and confidence, and through that has a big impact also on future academic outcomes (Murphy and Weinhardt, 2014). At neighbourhood level, neighbourhood composition and diversity can lead individuals to experience a position of relative inferiority, negatively affecting their feelings and behaviours. In fact, children may feel inferior by comparing their (lower) standard of living with that of their (richer) schoolmates and neighbours (Jencks and Mayer, 1990).

Passing on to the more structural characteristics, authors have found that the availability and quality of institutional resources within the local residential environment is important to explain neighbourhood effects (Jencks and Mayer, 1990; Small and Newman, 2001). Schooling quality, for example, has been defined as a primary mechanism through which neighbourhood context affects educational outcomes. However, the availability of other types of resources as well, such as libraries and social and public services, all matter for individuals' personal development and overall education (Sampson et al. 2002; Sirin, 2005). Klinenberg's research (2018), for example, highlights the role of social infrastructure as a glue holding communities together and fostering positive exchanges among residents. Social infrastructure, however, as well as school quality, tend to be scarcer in disadvantaged neighbourhoods, which makes it hard for individuals to improve their conditions. Along similar lines, Sampson et al. (2002) have also emphasised the relevance of land use patterns and the ecological distributions of daily

routine. The geography of the environment, for example the distribution and distance of malls from schools or public transportation routes, may be relevant to understand how and when children and teenagers come into contact with others.

Finally, a vast stream of research has developed around the environmental deprivation hypothesis. Socio-economic deprived areas are also characterised by greater environmental deprivation, physical and environmental hazards that bear on children's health and cognitive outcomes (Kawachi and Berkman, 2003). More disadvantaged neighbourhoods may be at the urban outskirts and in the most unhealthful parts of a city, for example closer to industrial centres or major highways. Thus, individuals living in such areas are more exposed to risks deriving from, namely, air pollution or lead poisoning, which significantly impact on individual health (Sampson and Winter, 2016). Housing conditions are also important in this respect. Houses and apartments in more deprived neighbourhoods are often in dilapidated conditions and built or repaired using cheap material, which make those who reside in them more exposed to allergens, toxins, and other structural hazards (Rosenfeld et al. 2010).

1.2. Neighbourhood and education-related outcomes

In the context of this thesis, I investigate the heterogeneous role of the neighbourhood context and how it affects different youth on different outcomes. I focus specifically on education-related dimensions of life attainment. In this chapter, I therefore present some conceptual clarifications over the three outcomes analysed within this dissertation: cognitive skills, non-cognitive skills and academic achievement.

1.2.1. Cognitive skills

Cognitive skills can be broadly defined as those abilities that involve intellectual and mental effort such as thinking, reasoning or remembering (Anderson, 1981). The IQ theory, which sees intelligence as the main factor behind educational performance, has a longstanding history and has been among the most widely debated in psychology, sociology and related fields (Nash, 2001). The study of cognition has been differently approached depending on the discipline and this has resulted in some inconsistencies in terminology and measurement strategies (Simpson, 1980).

In the debate about cognitive measures, a typical distinction is between tests of achievement and tests of ability (Dickens, 2008) or, in an alternative definition, between

crystalline and fluid intelligence (Keith and Reynolds, 2010). The former relates cognition to knowledge development, and encompasses abilities ranging from general knowledge, lexical understanding and language development. The latter, instead, is about individual's preparedness in solving new issues, regardless of previous knowledge. In the context of this thesis, and based on the available data (Moulton et al., 2020). I define and assess cognitive skills based on tests of achievement, thus, I focus on crystalline, rather than fluid, forms of intelligence. In order words, my definition of cognitive skills relate to skill/knowledge base acquired (e.g. knowledge of the fundamental meaning of words) and to the acquisition of skills related to written language and mathematics (Moulton et al., 2020). Nonetheless, it is important to stress that crystalline and fluid forms of intelligence are highly correlated because of functional overlap (Levy and Goldstein, 2014) and because of the difficulty of assessing each one excluding the other.

1.2.2. Non-cognitive skills

In 1976, the sociologists Bowles and Gintis first introduced the term non-cognitive skills with reference to differential behavioural socialisation in schools that accounted for the persistence of social class, beyond cognitive abilities. They were defined in particular as those characteristics that were valued by teachers in school and likely to be valued by employers later on (Bowles and Gintis, 1976). The renowned works by Cameron and Heckman (1993) and Heckman and Rubinstein (2001), which focused on the General Educational Development (GED) program, brought new and significant attention to the concept of non-cognitive skills. They find that earnings of individuals getting the GED, designed to allow people who do drop out from formal education to achieve a high school degree, are much lower than standard high school graduates, even if their qualification is supposed to be the same, and, most of all, as shown by Heckman and Rubinstein (2001), they show equivalent cognitive ability skills. This demonstrates how just "dropping out from school" (i.e., signalling low motivation and low persistence), negatively affects employers' perception and, thus, individual outcomes, beyond both cognition and formal achievement (i.e., obtaining a standard formal diploma). In 2003, Farkas reviewed the existing literature on the concept of non-cognitive skills, by reiterating that these should be conceived as the set of traits and behaviours that accrue rewards in the labour market, and distinct from traditional cognitive skills like literacy and numeracy. More recent definitions of non-cognitive skills also align with this idea, as shows the one provided by Kautz et al. (2014) in the context of human capital theory, according to which non-cognitive abilities

are: "*personality traits, goals, character , motivations, and preferences that are valued in the labour market, in school and in many other domains*" (p. 2).

Although the literature on non-cognitive skills is relatively old, it has been difficult to bring consistency to the related scholar tradition because of two main reasons. First, many different sub-dimensions have been identified as pertaining to the concept of non-cognitive skills. Second, and related to the first point, different labels naming conventions and labels have emerged, contributing to the fragmentation of the field.

There has been indeed little agreement among scholars (Guntman and Schoon, 2013) over what are really those characteristics that could be valued as much by teachers or employers. Therefore, the word non-cognitive has been used as an "umbrella" term gathering different concepts. In his review, Farkas (2003) differentiates between conscientious work habits (such as effort and task persistence) and positive psychosocial characteristics, such as sociability and obedience, which preclude antisocial behaviours like aggression and disruptiveness. Inferring non-cognitive skills via behavioural screening scales, that is by considering parents' or teachers' opinions on whether children exhibit a series of behaviour, has been one of the most common approaches (Attanasio, 2020). Under this perspective, two behavioural dimensions have been typically studied since they are considered important in affecting the process of learning and schooling experiences, internalising and externalising behaviours (Achenbach and Edelbrock 1978; Evensen et al., 2016). The former considers behaviours that have to do with anxiety and withdrawnness, which overall impact the ability of youth to focus their drive and determination. The latter relates instead to individuals' ability to engage in interpersonal activities, and takes into account the extent to which youth exhibits aggressive or violent behaviour. Gutman and Schoon (2013) divide non-cognitive skills in self-perceptions, motivation, perseverance, self-control, metacognitive strategies, social competencies, resilience and coping, and creativity. Goodman et al. (2015) list self-perception and self-awareness, motivation, self-control and self-regulation, social skills, resilience and coping, additionally outlining good emotional wellbeing as core to children's growth. In a 2018 research briefing, Shipton and Bermingham take perhaps the most comprehensive approach and distinguish (i) social and emotional skills such as communication, empathy, teamwork, self-awareness, confidence, self-belief, leadership, understanding and managing emotions, resilience, and collaboration; (ii) attitudes and values such as attitudes to learning, motivation, self-efficacy, tolerance, conscientiousness, citizenship, and respect, (iii) creative skills such as innovation, originality, and open-mindedness and (iv) metacognitive skills such as problem-solving, planning (including time management), self-control, and self-regulation. Finally, a number of

authors (Almund et al., 2011; Joshi, 2014) use well-validated measures of personality, and often the renown Big Five Model (McCrae & Costa 1987) as representing non-cognitive skills, although these are typically measured during adulthood.

Provided the heterogeneity of constructs that have been identified or could be defined as non-cognitive skills, defining such abilities has also not been straight-forward. In their pioneering work, Bowles & Gintis (1976, p. 135) used interchangeably the terms non-cognitive traits and personality traits. Over time, different labels have emerged, mostly based on the different scholar traditions in which they were embedded, and widely used as synonymous. For example, within economics and psychology, the term "non-cognitive skills" or "abilities" has been the most common. Nonetheless, other definitions such as "character skills", "soft skills" and "life skills" have also been extensively used. In sociology, the majority of authors have focused on "socio-emotional skills", a definition that highlights the social interaction and learning component of the aforementioned abilities. Several authors have also pinpointed a relative distinction between the semantic use of "traits", "skills" or "abilities" and "behaviours". The distinction among these terms builds on the idea that non-cognitive dimensions have both exogenous (innate), and endogenous (developed over time) aspects, whereas the endogenous creation of these skills and behaviours is largely a result of interaction with others and social mechanisms (Farkas, 2003). In fact, concerning non-cognitive aspects, "traits" mostly refers to their heritable or genetic component. The idea of "skills" and "abilities" is instead concerned with the fact that non-cognitive aspects are progressively shaped by the external environment. They can be fostered and learned, especially during the early life course (Kautz et al., 2014). With regard to "behaviours", instead, they are meant as the way such skills tend to manifest themselves, especially during the early life course.

1.2.3. Skills development and life success

The human capital debate stresses how returns to education depend on both cognitive and non-cognitive skills (Cunha and Heckman, 2007). On the one hand, research has emphasised the importance of cognitive skills for education. Many authors have found evidence for an association between cognitive skills and educational achievement (Kautz et al., 2014), often in combination with social class of origin (Bourne et al., 2018; Bukodi et al., 2019). A vast literature has gone further to understand to what extent education is rewarded on the labour market because of cognitive skills (Bowles and Gintis, 1976; Barone and van de Werfhorst, 2011). On the other hand, the increasing focus of academic as well as practitioners on non-

cognitive skills is justified by increasing evidence of the important contribution that such skills, in combination with cognitive ones, have on educational success and on overall individual life and development (Roberts et al., 2007; Blair and Razza, 2007; Duckworth and Seligman, 2005; Duncan and Magnuson, 2011; Valiente et al., 2010; Lleras, 2008). Cognitive and non-cognitive dimensions have indeed been consistently recognised as complementary and very much intertwined (Cunha and Heckman, 2007) in affecting not only educational outcomes, but also other relevant factors such as health (Carter et al., 2019), social mobility (Esping-Andersen and Cimentada, 2018), employment and occupation (Carneiro et al., 2007; Jackson 2006). Nonetheless, some have challenged the distinction between these two constructs. Borghans and colleagues, for example, note that "*few aspects of human behaviour are devoid of cognition*" (2008, p. 974), stressing that the line between the two cognitive and non-cognitive dimensions is far from being clear. Bourdieu (1977), as well, sees the boundary between "technical" (or cognitive) skill and "social-behavioural" (or non-cognitive) competence as mostly a social construction, built by ascendant interests to represent standards and criteria that preserve and justify the means of their ascendance (Edgerton and Roberts, 2014). Considering all this, in this dissertation I focus more intensively on these two relevant dimensions, trying to disentangle the role of the neighbourhood on their development. Nonetheless, I also consider more broadly academic achievement.

1.2.4. Academic achievement

Academic, or educational, achievement is one of the most relevant outcomes studied in social sciences. It is indeed a critical predictor of many other life outcomes such as occupation, social class, wealth or political opinions (Kingston et al., 2003). Differently from cognitive skills, typically educational achievement is concretely defined by measures that relate to the overall students' performance, beyond the mere acquisition of skills. For example, in terms of school drop-out, the highest level of education obtained (i.e. high school diploma or degree), or the total number of years of schooling. In this thesis, I focus on youth development, and look in particular to cognitive and non-cognitive skills. Nonetheless, I also consider academic achievement, up to the high school level. As a measure of academic achievement, I therefore align with previous works which has used the NCDS (i.e. Saunders, 1997) and define high school academic achievement in terms of a combination of the level of qualification obtained by students (which depend on the age up to which student have pursued their studies) and of the final grade obtained.

1.3. Empirical evidence on neighbourhood and educational outcomes

The majority of empirical works about the effect of the neighbourhood has highlighted negative effects on a variety of outcomes of residential segregation (Galster, 2012) and school segregation (Oberti and Savina, 2019). Overall, research on neighbourhood effects suggest that less disadvantaged environments positively affect children development and future prospects. The majority of research has developed in particular around the early life stages, either during childhood or adolescence (Chetty et al. 2016) for two main reasons. First, it is within this period of life that skills are conceived to be more malleable (Kautz et al., 2014) and, second, the external environment is deemed to have a stronger influence on youth development. Authors have found evidence for this relationship on various different outcomes such as cognitive development and educational achievement, but also employment, wages, physical and mental health, as well as residential outcomes later in life (Galster and Sharkey, 2017; Brooks-Gunn et al., 1993; Mayer and Jencks, 1989; Sampson et al., 2008; Sampson, 2012; Sharkey and Farber, 2014).

A recent review that looks into neighbourhood effects on different dimensions of children development (Leventhal and Dupéré, 2019) finds that greater neighbourhood advantage or affluence tend to be positively associated with children's achievement-related outcomes, such as school readiness, test scores, and overall educational attainment. A meta-analysis of the international literature (Nieuwenhuis and Hooimeijer, 2014) and a comprehensive review of the U.S. literature (Sharkey and Faber, 2014) also find similar neighbourhood effects on the development of cognitive skills, academic performance, and educational attainment. Concerning non-cognitive skills in particular, researchers have mostly focussed on measures of behaviour and (mis)conduct, rather than more proactive indicators of such skills. On this topic, a seminal paper is the 2002 review carried out by Sampson and colleagues, although more recent reviews of non-experimental studies also exist (Minh et al., 2017).

However, there is still not unanimous consensus. On the one hand, part of the inconclusiveness in findings can be explained by the fact that authors have studied different characteristics, or mechanisms, at the neighbourhood level, such the area ethno-racial composition, poverty, social disorder and so on (see, for example, Sampson et al., 2002). On the other hand, the variety of methodological strategies that have been used to assess

neighbourhood effects can also partly contribute to the puzzle. Although results from the experimental and methodologically more sophisticated literature are not remarkably distant from findings from non-experimental studies, effect sizes are often smaller (Galster and Sharkey, 2017; Leventhal and Dupéré, 2019), and some studies fail to report any associations.

Evidence on cognitive skills is particularly mixed. Many studies find a negative relationship between neighbourhood disadvantage and cognitive test scores (Ludwig et al., 2009, Casciano and Massey, 2012, Sharkey and Elwert, 2011). However, other studies fail to identify significant effects (Duncan, Brooks-Gunn, and Klebanov 1994; Brooks-Gunn, Klebanov, and Duncan 1996; Chase-Lansdale et al. 1997; Duncan, Boisjoly, and Harris 2001; Leventhal, Xue, and Brooks-Gunn 2006) and other even find the opposite, that is that adolescents who moved to middle-class neighbourhoods report lower grades than their peers in low-poverty neighbourhoods (Fauth et al., 2007). Experimental findings from the Moving To Opportunity (MTO) experiment also do not reach a coherent conclusion. In Boston, Los Angeles and New York City, no effect on cognitive performance is detected. In contrast, a strong and positive effect of moving out of disadvantaged areas is found for children in Chicago and Baltimore, which lasted over ten to fifteen years, but only for the Chicago sample (Burdick-Will et al. 2011; Ludwig, Ladd, and Duncan 2001; Sanbonmatsu et al. 2011).

While scholars have focused a lot on the role families (Anger and Schnitzlein, 2016) as well as of teachers and schools (Kautz and Zanoni, 2014, Nghiem et al., 2015) in promoting non-cognitive skills development, the role of neighbourhood with regard to this topic has been under-researched. A handful of authors, mostly in economics, have noted that neighbourhood characteristics are important mechanisms to foster non-cognitive skills. A working paper by Delabroye (2020) claims to be the first at assessing the role of the neighbourhood in teenagers' non-cognitive skills' development and finds neighbourhood quality to correlate with higher development of non-cognitive skills. List et al. (2020) focus on neighbourhood peer influence, stressing how this represents a key mechanism in generating positive non-cognitive spillover effects. A much greater number of papers focus on children and adolescent socio-emotional development, broadly conceived. Most papers find a significant positive association between neighbourhood socio-economic deprivation and internalising and externalising dimensions of problem behaviour. In particular, the level of neighbourhood disorder and perception of safety emerge as critical dimensions directly affecting youth emotional and behavioural outcomes (Brown and Ackerman, 2011, Bubier et al., 2009, Callahan et al., 2011, Fite et al., 2010, Froiland et al., 2014, Riina et al., 2014, Singh and Ghandour, 2012).

Finally, the majority of studies find a negative relationship between neighbourhood disadvantage and educational attainment. Individuals who grow up in disadvantaged neighbourhoods are found to be more prone to dropout from schools (Vartanian and Gleason 1999; Rendon, 2014; Harding, 2003) and less likely to graduate from high school (Crowder and South, 2011; Wodtke et al. 2011). Nonetheless, there are some exceptions, namely Plotnick and Hoffman (1999) who, adopting a robust fixed effect estimation strategy, fail to find any significant effect. In addition, even within studies that find an association, the nature and strength of the relationship tend to vary significantly by age (Chetty et al., 2016; Wodtke et al., 2016; Kleineper and Van Ham, 2018). In a debated re-assessment of the MTO data, for example, Chetty et al. (2016) find that moving into less disadvantaged areas increase college attendance rates, but only for individuals who moved when younger than 13 years old.

1.3.1. A focus on the UK neighbourhood research

Specifically in the UK, authors have found inconsistent evidence for the relevance of neighbourhood characteristics on cognitive abilities and academic achievement and, in contrast, an overall more consistent association between neighbourhood characteristics and non-cognitive outcomes.

During the 1970s, Gibbons (2002) shows that the adult's educational composition of the residential neighbourhood significantly affects adolescent cognitive skills, as well as later educational attainment. Youth from educationally advantaged communities achieve indeed higher reading and maths test scores than youth residing in relatively disadvantaged communities, and are also less likely to end up with no qualifications at age 33. Such a negative effect of growing up in relatively worse of neighbourhoods seems to persist across the 1980s (Gibbons, 2002). Garner and Raudenbush (1991) also analyse Scottish data on youth leaving school between 1984 and 1986, and find that living in living in a 10th percentile (less deprived) versus a 90th percentile (more deprived) neighbourhood deprivation area relates to a positive increase in academic achievement equivalent to around two O-level passes. During the 1990s and onwards, however, evidence on the role of neighbourhood deprivation on the development of youth cognitive skills seems to weaken. McCulloch and Joshi (2001) find, for example, that deprivation at the electoral ward level has a significant association with lower cognitive test scores only in children aged 4–5 years, with such association fading over time as children grow up. Weinhardt (2014) also fails to find any significant association between neighbourhood deprivation and teenage test scores.

At the same time, authors find a clearer pattern with regard to the association between area-level deprivation and different dimensions of problem behaviour, which seems consistent across time. Papers looking at data from the 1990s find relatively no or small evidence for the effect of neighbourhood characteristics on cognitive outcomes but, in contrast, a relevant effect on socio-emotional problem behaviour. McCulloch (2006) compares the influence of neighbourhood deprivation and family-level measures on both cognitive abilities and problem behaviour for youth in 1991. Both the size and the statistical significance of coefficients on the neighbourhood characteristics are smaller than those of family-level measures for cognitive abilities. Instead, neighbourhood characteristics are as significant as family factors in predicting higher levels of problem behaviour. Such results suggest in particular that parental and family conditions may partly mediate the effect of neighbourhood characteristics on youth developmental outcomes, confirming findings from qualitative studies from the US (Furstenberg, 1993) suggesting that parents in poor neighbourhoods use a variety of strategies both to protect their children from negative aspects of the neighbourhood and to find the resources their children need. Gibbons et al. (2013) consider instead peer mechanisms at the neighbourhood level, showing that these do not account for the development of cognitive skills but, instead, they do account for behavioural outcomes. Other works that focus on various dimensions of problem behaviour also find strong evidence of a role played by the neighbourhood (Odgers et al., 2009; Flouri et al., 2015, 2020; Visser et al., 2021). Such conclusions are, again, consistent with qualitative findings, both from the US (Anderson, 1999) and the UK (Arai, 2007). Various ethnographic accounts have evidenced how social interactions at the neighbourhood level matter for behavioural responses, especially among the most disadvantaged. Residents of poor neighbourhoods spend indeed more time in their local areas than do residents of wealthier neighbourhoods (Forrester and Kearns, 2001). In an analysis of social renters and owners on the same estates in Scotland, Atkinson and Kintrea (1998) found for example that the former conduct 60% of their daily activities within the neighbourhood, without involving networking with outsiders. In contrast, owners conduct three-quarters of their activities outside the neighbourhood, and in 90% of these cases they were not in contact with other people from their own estates. Moreover, in a study of English communities, Arai (2007) looks into the normative rules characterising deprived areas, emphasising how they might overall implicitly affect youth behavioural outcomes such as teenage pregnancy.

1.4. Beyond "Do neighbourhoods matter?": a theory-based approach

In the past decades, the literature on neighbourhood effects has enjoyed a great popularity and authors have produced a significant number of works trying to assess the role of the residential environment (Sampson et al. 2002, van Ham et al., 2012). Nonetheless, most of the empirical literature has focused on the existence of neighbourhood effects (Sharkey and Faber, 2014; Small and Feldman, 2012), while the specific theoretical mechanisms described in the previous paragraph and their implications have been much more rarely tackled. According to van Ham et al., 2012, p. 32 "*there is little doubt that neighbourhood effects exist, but after decades of research we seem no closer to knowing how important they are*", a statement that highlights the "black box" concerning the role of the neighbourhood on individual development as well as the processes through which neighbourhoods contribute to the production and re-production of social and educational inequalities (Jackson et al., 2009).

Nonetheless, with the field becoming increasingly mature, authors have started to try to build a more detailed and theoretical picture of the possible influence of the residential context. On the one hand, sociologists have started to consider more holistically children and adolescent development, as the product of cumulative interactions between the multiple contexts in which they interact (Bronfenbrenner & Morris, 2006), rather than focusing on single and isolated developmental conditions. Such ecological perspective stems from development psychology (Bronfenbrenner, 1979; Ceci, 2006), and consists in putting the individual at the centre of a series of embedded and interrelated conditions and contexts (Leventhal and Dupéré, 2019). On the other hand, there has been some recognition that neighbourhoods might affect different individuals in very different ways, depending on their individual and contextual characteristics (Small and Feldman, 2012). Harding et al. (2010) stress indeed that young adolescents who live in similar neighbourhoods may experience them in very different ways. This therefore creates some effect heterogeneity, for which neighbourhood effects may take on even opposite directions or be of a different magnitude for different youth. As Small (2004, p. 176) argued based on research in a Puerto Rican housing complex in Boston, researches should indeed "*use heterogeneity in responses to neighbourhood poverty as the starting point rather than [something] to ignore….*". Similarly, in a review of the literature on neighbourhood effects on children's academic outcomes, Burdick-Will et al. (2010) argue that while we can reject the null hypothesis that neighbourhood environments *never* matter for children's outcomes, we can also reject the hypothesis that they *always* matter (Burdick-Will et al., 2010). Such findings

echo the call, not only for a better understanding of underlying mechanisms of neighbourhood effects, but also for analyses of their heterogeneity across context at the family and individual level (Sharkey and Faber 2014).

The combination of a more holistic approach, recognising that multiple contexts and situations can jointly drive developmental outcomes, but also a somehow individualistic approach, which therefore considers individuals' own situations and specific characteristics, has led to a more refined theory about neighbourhood effects. In recent efforts, Levy et al. (2019) and Levy (2019, 2021) present four theoretical hypotheses on neighbourhood effect heterogeneity on educational achievement: cumulative advantage, cumulative disadvantage, advantage levelling, and compensatory advantage. Such a framework, presented in Figure 1.1 below, stresses that neighbourhood conditions may affect different individuals in different ways, thus answering to the heterogeneity call, because of the combination of different contexts and/or individual conditions which themselves represent sources of social advantage or disadvantage.

Figure 1.1. Summary of existing theoretical models concerning neighbourhood effect heterogeneity

Neighborhood Effects Disproportionately Accrue to:	Benefits of Neighborhood Advantage	Harms of Neighborhood Disadvantage
Disadvantaged Individuals	*Compensatory*	*Cumulative disadvantage*
Advantaged Individuals	*Cumulative advantage*	*Advantage leveling*

Note: Levy et al., 2019

Looking jointly at individual and neighbourhood conditions of advantage, the cumulative advantage theory posits these two sources of advantage tend to compound over time or over each other (DiPrete & Eirich, 2006, Dannefer, 2003). In contrast, the cumulative disadvantage hypothesis focuses on conditions of neighbourhood disadvantage, arguing how such conditions compound over time or with other forms of individual disadvantage to produce the most negative outcomes for youth. According to the advantage leveling hypothesis, neighbourhood disadvantage would reduce some of the benefits previously accumulated through other sources of advantage. Finally, opposite to the advantage leveling model, the compensatory hypothesis focus on the positive effect of living in advantaged neighbourhood conditions for those youth with other and previous forms of social disadvantage.

In the three empirical chapters of this thesis, I expand and contribute to this theoretical framework in two ways.

First, I take into account relatively new individual dimensions as form of advantage/disadvantage, moving beyond the family SES dominancy. As argued by Levy (2021) indeed, only family SES has coherently been analysed as a specific form of individual advantage (or disadvantage). Applying this theoretical perspective in the context of household SES is straightforward. Measures or neighbourhood and family SES tend to be very similar and related to each other. Similarly to the neighbourhood, living in a high-SES family represents a source of individual advantage, in comparison to living in a low-SES family, which is instead a source of individual disadvantage. However, other types of individual characteristics might matter in driving heterogeneity in neighbourhood effects. In particular, I focus in this thesis on three sources of potential individual heterogeneity: gender, past trajectories of neighbourhood disadvantage, and education-related genes.

Second, I expand with regard to the theoretical hypotheses of effect heterogeneity the have so far been most commonly tested. The cumulative disadvantage theory has so far predominated the neighbourhood literature and attracted the greatest scholar attention in the field. Seminal works (Wilson, 1987; Jencks & Mayer, 1990) rely on such theory. More recent research also find evidence for it, by looking at cumulative exposure to neighbourhood disadvantage over time (i.e. Clarke et al., 2014; Hedman et al., 2015; Alvarado, 2016; Pinchak and Swisher, 2022) or the combination of neighbourhood disadvantage and family socio-economic disadvantage (Ananat et al., 2011; Crowder and South, 2003; Wodtke et al., 2016).

Within this thesis, the cumulative disadvantage hypothesis represents also the starting point of the empirical contribution. However, I acknowledge that different hypotheses also exist and I refer to them, as well as empirically test them, depending on what seems most appropriate. Concerning these other hypotheses, indeed, evidence is overall scarce. One recent work has provided evidence coherent with the advantage levelling hypothesis in the context of college outcomes in the US (Levy, 2019). Moreover, the compensatory advantage hypothesis has been corroborated with real-life observations from the MTO or Gautreaux interventions (Levy et al., 2019). These experimental programs indeed provided low-income families living in high-poverty neighbourhoods with vouchers to move to low-poverty areas, thus attempting to attenuate these past forms of disadvantage through advantages associated with the opportunity to relocate to less deprived areas. Some of the findings related to these studies support the compensatory advantage hypothesis, finding that moving to low-poverty neighbourhood does improve educational outcomes (Chetty et al., 2016; Rosenbaum, 1995).

In Chapter 3, which represents the first empirical analysis of this thesis, I study neighbourhood disadvantage and how it interacts with gender as individual source of heterogeneity. The integration of gender within neighbourhood studies is not new. A variety of quantitative and qualitative studies have tried to clarify whether living in a more or less disadvantaged environment when growing up differently shapes outcomes for girls and boys. In particular, studies from the MTO have looked into gender-based differences on several outcomes, such as education but also health and socio-emotional behaviour (Clampet-Lundquist et al., 2006; Popkin et al., 2008). However, findings concerning the differential impact for girls and boys of being exposed into a more or less deprived residential area are inconclusive. With Levy's (2021) framework in mind, I therefore try to review and re-assess gender-based heterogeneity in the effect of the neighbourhood on a rich set of cognitive and non-cognitive outcomes.

When it comes to gender, developing a combined hypothesis for the joint effect of neighbourhood disadvantage and individual conditions is not straightforward. Differently from family SES, it is not possible to make an a priori consideration for which being a male or a female does represent a form of disadvantage. Rather, as detailed in chapter 4, different theories propose different reasons for which identifying with a specific gender could result, in combination with conditions of neighbourhood disadvantage, in worst cognitive and/or non-cognitive outcomes. For example, authors stress the differential spatial trajectories of young boys and girls, based on which male might be more exposed to the residential area characteristics, as well as the gender-segregated nature of the informal labour market in poor neighbourhoods as responsible for making males, as compared to females, more at risk, in the context of neighbourhood disadvantage. Under this view, being a male can cumulate with living in a deprived area – resulting in worst overall cognitive and non-cognitive outcomes. On the other hand, theory highlights how disadvantaged neighbourhoods might represent worst environment for girls, or, alternatively stated, being a female can cumulate with living in a deprived area, driving worst overall outcomes. In disadvantaged areas, female may indeed experience greater risk of sexual harassment and related problems driven by neighbourhood disorder. In addition to that, in these areas gender stereotypes tend to be stronger and social support by teachers and adult role models may be lacking, leading to an overall greater dissatisfaction for young females. Table 1.1 summarizes these different mechanisms, for which neighbourhood effects, and the effect of neighbourhood disadvantage in particular, would accrue disproportionally to either males or rather females.

Table 1.1. Harms of neighbourhood disadvantage, by gender.

Neighbourhood effects disproportionally accrue to:	Mechanisms:
Male (Disadvantaged)	Spatial trajectories: males more outdoors, females more indoors Informal labour market, driving more easily male youth into criminal behaviours
Female (Disadvantaged)	Sexual harassment and other risk-factors connected to neighbourhood disorder Greater gender stereotypes Lack of sufficient support

Note: Table adapted from Levy et al., 2019

Relying on these theories, in Chapter 3 I test the interaction between neighbourhood deprivation and adolescent gender on a broad range of cognitive and non-cognitive skills, in order to shed new light upon the question of "*for whom do neighbourhoods matter?*". I additionally discuss and provide some descriptive evidence concerning which possible mechanisms may explain my findings.

In Chapter 4, I consider more specifically the role of time. The fact that the temporal dimension has been significantly and consistently under investigated represents one of the most serious criticisms to the neighbourhood effects literature (Sharkey and Elwert, 2011; Sharkey and Faber 2014; Musterd et al., 2012). While some authors have started making efforts to consider a longer time frame to assess the systematic effect of living in a disadvantaged area (Sampson et al., 2008; Wodtke et al., 2011; Kleinepier and Van Ham, 2018), just a bunch of studies have tried to go beyond a single generation by considering neighbourhoods in a multigenerational perspective (Sharkey and Elwert, 2010; Sharkey and Elwert, 2011; Hedman et al., 2015; Alvarado and Cooperstock, 2021). Within this work, I expand on this line of inquiry by exploring multigenerational neighbourhood effects on youth cognitive and socio-emotional outcomes.

In particular, I respond to the call posed by an increasing number of researchers who stress that inequality has longstanding roots and that adopting a multigenerational perspective is important to understand processes of transmission of opportunity as well as the reproduction of inequalities over time (Mare, 2011).

A first part of the empirical analysis carried out in Chapter 4 relies on the cumulative disadvantage hypothesis. I indeed consider how exposure to neighbourhood disadvantage across two different generations, independently but also cumulatively, affects youth development. I test whether $NEIGH_{CURR}$, that is the neighbourhood where the parents are currently living and where the offspring generation is growing up, influences their cognitive and socio-emotional outcomes. I then explore whether $NEIGH_{PAST}$, that is the neighbourhood where the grandparents were living at the time when parents were 16 years old, has also an influence on the same outcomes. The underlying argument is that exposure to neighbourhood deprivation cumulates over time and, in this case, across generations, so that youth with the greater exposure to such negative environment will experience the worst outcomes. In a second step, I enlarge this thinking by looking at the different multigenerational trajectories of neighbourhood exposure. I classify individuals based on whether they have lived consistently, across two generations, in a deprived area, in a non-deprived area, or rather moved from a deprived to a non-deprived area or viceversa. The underlying argument is that different trajectories represent specific forms of individual advantage or disadvantage. Under this view, I am able to more clearly compare youth with a trajectory of neighbourhood deprivation across generations with youth characterised by different trajectories, coherently with Levy's framework (2021) as proposed in Table 1.2.

Table 1.2. Neighbourhood effects, by neighbourhood trajectory of disadvantage.

Neighbourhood effects disproportionally accrue to:	$\boldsymbol{NEIGH_{CURR}}$ Non-Deprived	$\boldsymbol{NEIGH_{CURR}}$ Deprived
$\boldsymbol{NEIGH_{PAST}}$ Deprived	Compensatory advantage	Cumulative disadvantage
$\boldsymbol{NEIGH_{PAST}}$ Non-Deprived	Cumulative advantage	Advantage levelling

Note: Table adapted from Levy et al., 2019

Overall, by comparing the effect on cognitive and socio-emotional outcomes of youth with different trajectories of neighbourhood deprivation I am thus able to integrate a longer-term perspective to neighbourhood studies, considering individuals and the variety in the interaction with their neighbourhoods across and beyond their life (Sampson et al., 2002; South et al., 2016; De Vuijst et al., 2016).

Finally, in Chapter 5, I change perspective and focus specifically on conditions of neighbourhood *advantage*, i.e. lower neighbourhood deprivation. More specifically, within this chapter I focus on the interaction between conditions of neighbourhood advantage and an under-studied individual characteristic, which is education-related genetic endowment.
Individual education-related genes represent an important (and somehow innate) condition of individual advantage or disadvantage. In particular, based on works integrating genetics within social science, more education-related genes (summarised in the so-called Polygenic Score (PGS), see Chapters 2 and 5 for additional details on the operationalisation) tend to be associated with better educational outcomes, and they can therefore be assumed to represent an individual form of social advantage. On the contrary, lower levels of education-related genes, or lower PGS, can be assumed to represent a form of individual social disadvantage.

The most renown theory in behaviour genetics that looks the joint effect of individual contextual conditions and individual education-related genes, also called gene-environment interactions (GxE), is the Scarr-Rowe hypothesis (Rowe, Jacobson and Van Den Oord, 1999; Scarr-Salapatek 1971). According to such theory, higher SES environments provide resource-rich environmental conditions that are tailored to children's needs, thus facilitating the realization of genetic influences on IQ and educational achievement. This theory well-resonates with the cumulative advantage hypothesis, based on which individuals in a position of relative advantage (i.e. higher genetic predispositions) are therefore the ones that should benefit more from conditions of neighbourhood advantage. This also aligns with other theories on educational advantage, such as the "skill begets skill" idea of human capital (Heckman, 2000), according to which early advantages are the foundations of advantages later on. To the other side of the spectrum of to whom, the specific benefits of neighbourhood advantage may accrue, an alternative hypothesis exists. The compensatory advantage theory stresses indeed that living in a conditions of neighbourhood advantage can ameliorate some of the negative impacts associated with a position of relative individual disadvantage. Based upon this theory, the benefits of living in an advantaged residential area should accrue disproportionally to those individual who might need them the most, that is, relatively disadvantaged individuals, which in this case would mean individuals characterised by lower genetic predisposition. Table 1.3 below summarizes these two competing hypotheses.

Table 1.3. Benefits of neighbourhood advantage, by individual genetic predispositions.

Neighbourhood effects disproportionally accrue to:	Mechanisms:
Advantaged Individuals (Higher PGS)	Cumulative advantage / Scarr-Rowe hypothesis
Disadvantaged Individuals (Lower PGS)	Compensatory advantage hypothesis

Note: Table adapted from Levy et al., 2019

In chapter 5, I empirically assess which one of these two alternative hypotheses, the typical Scarr-Rowe theory against the compensatory advantage hypothesis, holds when it comes to the interaction between individual education-related genes and neighbourhood advantage on three education-related outcomes: cognitive skills, academic motivation and academic achievement.

In conclusion, throughout the thesis, I contribute to the understanding of neighbourhood effects and its heterogeneity by considering or re-considering specific forms of individual advantage or disadvantage and by expanding the hypotheses analysed beyond the prevailing cumulative disadvantage theory. By doing so, I aim provide a more comprehensive perspective on the complex relationship between individuals, neighbourhoods, and education-related outcomes.

Chapter 2

Heterogeneity in neighbourhood effects: challenges and methodological approaches

In this chapter, I first provide some context with regard to dynamics of spatial inequality and segregation in the UK during the period of interest of this thesis. Second, I introduce the data I will be using, the 1958 UK cohort, or National Child Development Study (NCDS), as well as Census-based information on neighbourhood deprivation. Third, I move on to discuss the methodological approaches typically used in neighbourhood research. I begin by touching upon the challenges associated with typical observational studies, in particular the problem of selection, and present some innovative methods proposed by researches to circumvent these issues. I then detail how researchers have used experimental and quasi-experimental methods. I focus on describing how I use one particular strategy, which is relying on the allocation policy of social housing in the UK, as a mean to reduce issues of neighbourhood selection, and to provide more robust estimates in my empirical chapters. Finally, I touch upon the contribution of qualitative methods to neighbourhood theory.

2.1. Neighbourhood and spatial inequalities in the UK

Spatial inequalities have been for a long time a prominent feature of the United Kingdom's socio-economic landscape. Currently, the UK represents one of the most unequal country in the industrialised world, with such inequality been significantly geographically determined (UK, 2019). However, social polarisation in Britain dates back to at least the 1970s (Engstron, 1997; Dorling & Rees, 2003).

The period starting in the 1970s up to the 1990s, which is the time that this dissertation considers, is important when it comes to spatial dynamics of inequality. Although deprivation levels overall decreased across the country, during this period various factors indeed contributed to the segregation of communities along geographic lines, resulting in distinct patterns of inequality and uneven development.

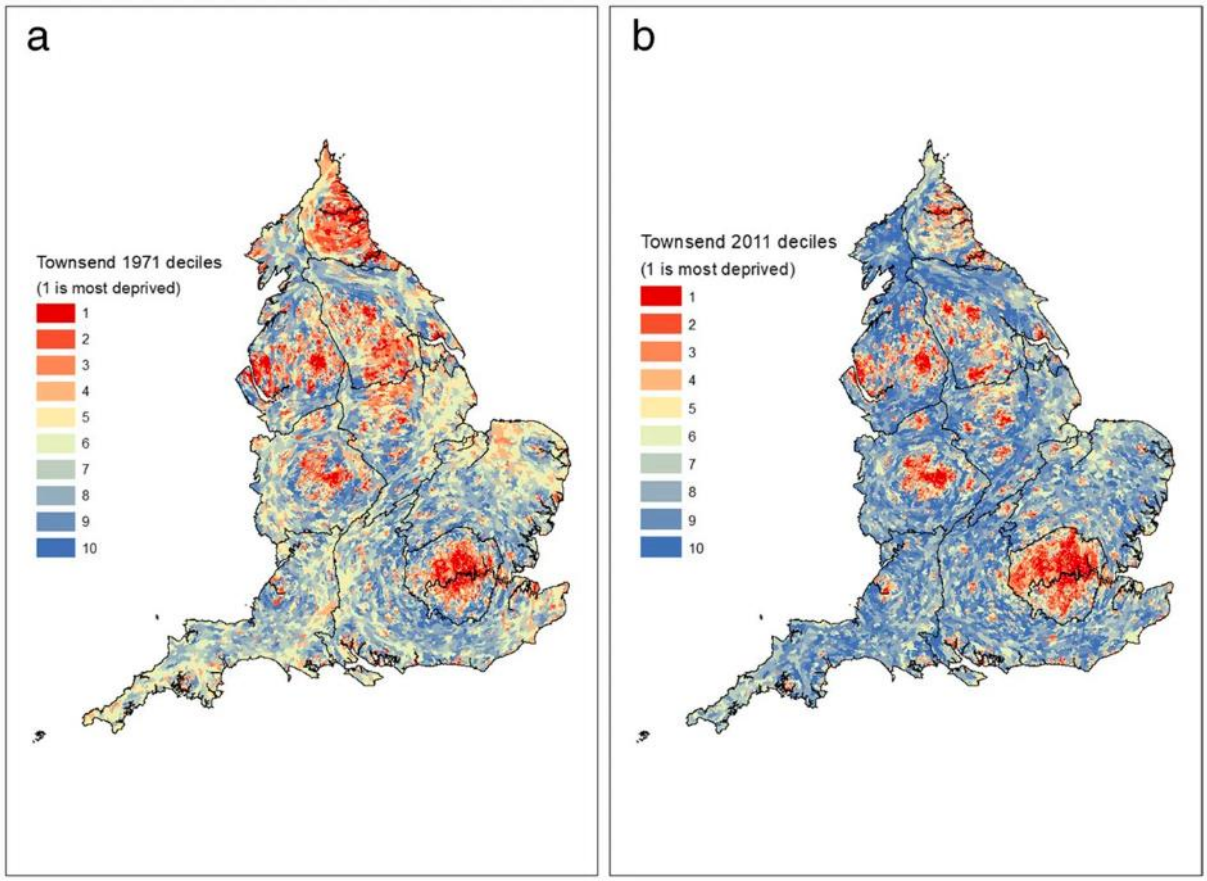
First, the UK experienced a severe process of de-industrialisation, a critical decline of traditional industries and rising unemployment. Between 1961 and 1976, nationwide manufacturing declined 14 per cent for a total of 1.2 million jobs lost; mining and quarrying employment fell 48.4 per cent for a total of one-third of a million jobs (Rowthorn, 1986). Such processes of de-industrialization and changes in labour markets did not take place evenly, but rather contributed to growing regional disparities and exacerbate the country’s North-South divide (Patias et al., 2021). Areas such as London and the Southeast experienced better economic prospects, thanks to the concentration of financial and service sectors. In contrast, areas that heavily relied on traditional industries such as coal (i.e. the North, Midlands and

Wales) faced significant economic stagnation and decline. High unemployment rates and limited job opportunities in these regions perpetuated the cycle of poverty and limited social mobility, contributing to increasing spatial segregation.

Within Britain's major cities, also as a result of the stagnating economic situation, massive processes of urban renewal and redevelopment took place. Such processes were aimed at clear inner city areas, modernise urban spaces and improving overall living conditions. Central neighbourhoods experienced a vast shrinkage in working-class population (Martinez-Fernandez et al., 2012), who was displaced towards the periphery of the city. Racial and ethnic disparities also played a role. Migrants from former colonies, such as the Caribbean, India or South Asia, and who often converged within the poorer, central neighbourhood because of discrimination and limited access to housing were also displaced, leading to the formation of ethnic enclaves within, and more often at the border, of major urban areas (Peach, 1992).

From a political point of view, although the Labour party, which had come into power in 1974, had tried to address some of the most pressing social issues, these efforts had been overthrown by the following implementation of neoliberal policies and economic restructuring (Mulrenan, 2019). In more recent years, inequality dynamics have, if anything, exacerbated. The figure 2.1. below, retrieved in Lloyd et al. (2023) is a descriptive map of neighbourhood deprivation in the Great Britain in 1971 and 2011, based on the Townsend Index, which is the same measure of area deprivation that I use in my analysis.

Figure 2.1. Townsend score in (a) 1971 and (b) 2011 at the neighbourhood level



Note: Lloyd et al., 2023

From this figure, two things emerge. On the one hand, across 50 years the UK seems to have experienced a generalised pathway of upward socioeconomic mobility, resulting in a generalised improvement of British neighbourhoods. In their work on British neighbourhood trajectories, for example, Pitias et al. (2021), highlight indeed that the most (60%) of British neighbourhoods have moved upwards in the socioeconomic hierarchy while only about 20% of those at lower end of the socioeconomic hierarchy have remained substantially stable. Second, the main geographical patterns in 1971 and 2011 are similar, with most urban centres and northern regions showcasing neighbourhoods in the most deprived deciles. This suggests that the social polarisation between affluent and disadvantaged areas, across income, age, socioeconomic status and ethnic groups, has been persistent, as also confirmed by other studies (i.e. Dorling et al., 2007; Fahmy et al., 2011), perpetuating socioeconomic inequality across Great Britain (Dorling & Rees, 2003; McLachlan & Norman, 2021). In fact, we observe a more marked contrast between less deprived and more deprived areas in 2011 than in 1971, which was characterised by less stark differences in between the two and more mildly-deprived areas.

Policy contributed to this shift. As an example, the notorious Right to Buy, implemented in 1980, played a significant role in exacerbating segregation dynamics. Overall, this resulted in a concentration of disadvantaged and minority populations in specific locations, creating pockets of poverty and isolation. The country experienced an increasing polarisation of income and wealth at the local level, producing at the same time a greater spatial segregation between better-off and poorer areas (Green, 1996), as well as a growth in concentrated poverty amongst communities, especially within urban areas (Noble & Smith, 1996). Considering all this, local neighbourhoods became a critical dimension for understanding of the distribution of economic resources and social stratification in Great Britain (Green, 1996; Noble & Smith, 1996).

2.2. Introduction to the NCDS data

In this dissertation, I use an ongoing longitudinal survey in the UK, the National Child Development Study (NCDS). The NCDS survey includes individuals who are all born in the same week in 1958 and interviewed at age 7, 11, 16, 23, 33, 42, 44, 46, 50 and 55, with the latest sweep (age 62) currently in the field. The goal of the survey is to foster the comprehension of the determinants which affect human development over the whole lifespan from birth. The NCDS is indeed one of the first cohort studies in the UK, and has been later followed by others of the same kind, namely the 1970 British Cohort Study (BCS), the 1991 Next Steps and the 2000 Millennium Cohort Study (MCS). Table 2.1 below presents the pattern of survey response by sweep.

Table 2.1. 1958 British National Child Development Study survey response by sweep.

	Sweep 0 (age 0)	Sweep 1 (age 7)	Sweep 2 (age 11)	Sweep 3 (age 16)	Sweep 4 (age 23)	Sweep 5 (age 33)	Sweep 6 (age 42)	Biomedical sweep (age 44)	Sweep 7 (age 46)	Sweep 8 (age 50)	Sweep 9 (age 55)
Productive	17415	15425	15337	14654	12537	11469	11419	9377	9534	9790	9137
Refusal	0	80	797	1151	915	1365	1148	2829	1448	1214	582
Non-contact	218	1036	406	786	1675	1394	1832	792	612	835	860
Other unproductive	0	173	202	295	413	953	263	31	109	332	491
Ineligible	0	0	0	0	0	0	13	65	11	81	0
Not Issued*	925	548	275	0	862	993	1415	2908	4248	3553	4543
Not Issued – Emigrant	0	475	701	799	1196	1335	1268	1234	1272	1293	1286
Not Issued – Dead	0	821	840	873	960	1049	1200	1322	1324	1460	1659
Total	18558	18558	18558	18558	18558	18558	18558	18558	18558	18558	18558

*Sweep 0-2: Immigrant – not resident in Great Britain; Sweep 4-9: no address or refusal to participate.

Notes: Information taken from Johnson J, Brown M. National Child Development Study: User Guide to the Response and Deaths Datasets. London: Centre for Longitudinal Studies. 2015

I focus solely on Sweep 3 (Chapter 3 and Chapter 5), carried out when individuals cohort members were 16 years old or jointly with Sweep 5 (Chapter 4), carried out when cohort members were 33 years old. On the one hand, I look at the teenage period (Sweep 3) since I am interested in the effect of neighbourhood disadvantage on youth development. Neighbourhood information was not collected prior to Sweep 3, which prevents me from focusing on assessing neighbourhood effects during cohort members' childhood. On the other hand, Sweep 5 includes, in addition to the main survey, the unique "*Mother and child*" study. This survey focuses on second generation NCDS children aged 5-17. This specific questionnaire was completed by 1 out of 3 cohort members randomly selected, who declared to have at least one child old enough to be assessed by then.

The NCDS collects information on a variety of domains, from physical and educational development to economic conditions and family life and, as such, it has been extensively utilised in studies on the reproduction of social inequalities. The NCDS is particularly well-suited for the empirical analyses which will follow in this thesis, since they include comprehensive information on: education-related outcomes, neighbourhood disadvantage, individual and contextual characteristics, individual genetics predispositions.

Outcome variables

In the empirical analyses, I exploit rich information on both cognitive and non-cognitive dimensions, as well as on academic achievement. Table 2.2 below provides an overview of the cognitive and non-cognitive outcomes available in the survey and used within this thesis, with information about the empirical chapter in which each of them is analysed and some relevant reference papers which have used the same constructs.

Table 2.2. Overview of NCDS Relevant Outcomes

CM Age	Outcome	Ch. 3	Ch. 4	Ch. 5	References
Age 16	CM Cognitive Ability	X	X	X	Goodman and Sianesi (2005); Power and Hertzman (2008); Fogelman (1978); Jeffers et al. (2002)
	CM Overall Non-Cognitive Ability	X			Carter et al. (2019)
	CM Academic Motivation	X		X	Joshi, 2014; Breen and Goldthorpe 1999 ; Schoon, 2008
	CM Lack of Internalising Behaviour	X			Buchanan and Brinke (2018); Maggs et al., (2008)
	CM Lack of Externalising Behaviour	X			Buchanan and Brinke (2018); Maggs et al., (2008)
Age 23	CM School Examination results			X	Saunders (1997)
Age 33	SGEN Cognitive skills		X		Michael (2003); Armstrong (2012); Parcel and Campbell (2017); McCulloch and Joshi (2001); McCulloch (2006)
	SGEN Socio-emotional behaviour		X		Verropoulou et al. (2002); McCulloch et al. (2001); McCulloch (2006); Blanden and Machin (2008, 2010)

Notes: CM stands for cohort member; SGEN stands for second-generation children.

A clarification over the definition of non-cognitive skills.

In this thesis, my approach to the definition of non-cognitive skills is tailor-made to each empirical chapter, since in each of them I investigate and analyse different sub-dimensions of the non-cognitive bucket.

In Chapter 4, I adopt a broad definition of non-cognitive skills, since I investigate four different and varied non-cognitive outcomes. I discard the more classical sociological term of socio-emotional behaviour because I believe that not all of the outcomes I look at have an embedded socially interactive nature. Two of them surely do, as they are indeed the two

internalising and externalising dimensions that are usually defined as socio-emotional behaviours. However, the other two dimensions, academic motivation and employability skills, are much more related to school and work and more typically align with scholarly traditions that have defined them as non-cognitive skills (Bowles & Gintis, 1976; Farkas, 2003). In Chapter 4, due to data availability, I focus solely on internalising and externalising behaviours, and thus I define them as socio-emotional behaviours, rather than more broadly non-cognitive skills. Finally, in Chapter 5, I focus on a non-cognitive dimension, which is academic motivation, which makes the definition straight forwards.

Information about the operationalisation of each of these outcomes is included in the relevant empirical chapter.

Neighbourhood information

The main focus of this thesis is on neighbourhood conditions, which is the main independent variable of interest throughout the analyses. Neighbourhood characteristics are thus retrieved by matching the geographical identifiers available through the NCDS with information from the UK census. I define the neighbourhood at the level of Lower Layer Super Output Areas (LSOAs). There are 34,753 LSOAs in the UK and each LSOA contains between 1,000 and 3,000 people.

As a measure of neighbourhood disadvantage, I use the Townsend Index of deprivation (Townsend et al., 1988; Lloyd et al., 2023; University of London, 2022). The Townsend Index is a composite measure deriving from four Census variables:

- unemployment (as a percentage of those aged 16 and over who are economically active)
- non-car ownership (as a percentage of all households)
- non-home ownership (as a percentage of all households)
- household overcrowding (as a percentage of all households).

Nowadays, the Townsend Index has been updated into more refined and multidimensional measures of neighbourhood deprivation, such as the Index of Multiple Deprivation (Department of Communities & Local Government 2015). Nonetheless, in the context of the 1970s, the Townsend score represents a reliable measure of deprivation and has indeed been widely used in the literature (McCulloch & Joshi, 2001; Murray et al., 2021).

Individual and contextual characteristics

The NCDS includes detailed information on individual and contextual characteristics. Overall, I consider individual information, such as gender and ethnicity; parental and household characteristics, for example parental education and household size, and, in some instances, also school characteristics. In each empirical chapter, a slightly different set of covariates is taken into account to best fit the empirical model, although I have tried to uniformly operationalise them as much as possible. Hence, the operationalisation of such variables is discussed in detail in each relevant chapter.

Genetic information

The NCDS includes genetic information for a subsample of the participants. Genetic information was collected retrospectively and, more specifically, in a biomedical survey which included the collection of DNA samples (Power & Elliot, 2005) and that was conducted when individuals were aged 44. Out of 9,339 individuals who participated in the sweep, 90% agreed to provide blood samples for extraction, storage and analysis of DNA. However, individuals were genotyped in different projects and iterations, and not all samples could be analysed. Therefore, full genetic information is provided for N=6,435 individuals. More information on the DNA collection and extraction is provided in the technical report attached to the biomedical sweep (Fuller et al., 2006). More details about the inclusion of genetic information in the empirical analysis within this thesis are provided in the dedicated Chapter 5.

2.3. Empirical approaches to neighbourhood research

The neighbourhood literature has over time been very rich with regard to the type of methods which authors have employed to study neighbourhoods' characteristics that shape the formal and informal social structures influencing community dynamics and individual outcomes.

The seminal work by Wilson, "The Truly Disadvantaged" (1987), marked the start of contemporary research on neighbourhood effects (Small and Feldman, 2012). This influential publication was indeed one of the first to explore the effects of neighbourhood characteristics, such as concentrated poverty, crime, and limited social capital, on the life chances of individuals living in disadvantaged neighbourhoods.

Since then, quantitative studies have flourished, trying to assess the influence played by a variety of neighbourhood characteristics, such as neighbourhood poverty, poor educational climate, social disorder or social control (Jencks and Mayer 1990; Small and Newman 2001; Sampson et al. 2002; Sampson 2008; Nieuwenhuis and Hooimeijer, 2016) on important life

outcomes. The great majority of these quantitative works concerning neighbourhood effects are observational in nature (Oakes et al., 2015; Menendhall et al., 2006). Most papers rely upon non-experimental data and often employ standard OLS or multilevel (i.e., mixed effect regression) techniques to identify the role of the neighbourhood context independently from other and individual characteristics.

However, these papers often present two critical issues. The first is that they fail to take into account the assumptions behind multilevel approaches and do not inherently address the key methodological concern in identifying neighbourhood and area effects, that of neighbourhood selection (Manski, 1993; Dietz, 2002). The major challenge with purely observational studies is indeed the endogeneity of neighbourhood effects related with, for example, family background, schooling or intentions to move. Studies focusing on the intersection of families, schools and neighbourhood show, for example, a complex interplay of these factors and neighbourhood effects (Calarco 2014; Stevenson and Baker 2016; Patacchini and Zenou 2011; Sastry and Pebley 2010; Wodtke and Parbst 2017). Since taking into account all relevant (social) dynamics to identify a genuine neighbourhood effect in observational studies is challenging (Entwisle 2007), this has resulted in persistent scepticism directed towards findings resulting from research which do not rely on a quasi-random variation in neighbourhood conditions (Sharkey and Faber 2014). Second, the temporal dimension has been significantly and consistently underestimated and typically observational studies have focused on a single point of time estimate of neighbourhood effects (Sharkey and Elwert, 2011; Sharkey and Faber 2014; Musterd et al., 2012; Small and Feldman, 2012). The adoption of a longer perspective to neighbourhood research requires instead the adoption of more complex and dynamic modelling techniques, in order to provide new insights as to the mechanisms and pathways through which neighbourhoods exert their effects (Elder et al., 2015). From studies in life course epidemiology, which often adopts longitudinal empirical strategies, it is known that there are several pathways through which effects persist or vanish over time (Bauldry et al 2012; Kuh et al 2003).

In an effort to respond to these issues, in the last few years an increasing number of empirically oriented papers relying on observational data have started to develop and use what one might call causal methods to better identify neighbourhood effects in a dynamic and longitudinal perspective. In 2003, a seminal paper by Harding used propensity score matching to estimate neighbourhood effects by exploiting longitudinal data. Since then, several researchers have relied on that or similar counterfactual approaches which assess differences between individuals exposed to certain neighbourhood conditions and unexposed but otherwise

similar peers with closely matched propensities for exposure (Sampson et al. 2008, Wodtke et al. 2011). All such methods have been detailed in a number of methodological reviews. Namely, Galster and Sharkey (2017) summarize the variety of empirical strategies that fall into this category, including fixed effects, siblings and family-based studies, movers vs- non-movers' comparisons. More recently, Brand et al. (2023) have assessed the advances in causal inference which are relevant to sociological studies, focusing on a selective subset of methodological contributions relating to causal effect identification and estimation in general, to the identification of causal effect heterogeneity, to causal effect mediation, as well as to temporal and spatial interference.

One of these methods, which I will also use in this thesis, is the Regression-with-Residuals (RWR) strategy (Wodtke, 2018; Wodtke et al., 2020). This approach allows to obtain estimates that are more causally robust, under certain assumptions described in Wodtke (2018) and Wodtke et al. (2020) and that will also be discussed in the relevant empirical Chapter 4. RWR it has previously been applied in several sociological studies and also more specifically in the context of neighbourhood research. Klein & Kühhirt (2021) use it for example to study the direct and indirect effects of grandparent education on grandchildren's cognitive development, theorising the role of parental cognitive ability. Carbonaro et al. (2023) focus instead of school poverty composition, and estimate its effects on eighth-grade reading and math test scores. Within the neighbourhood field, the RWR method has been used to estimate cumulative neighbourhood effects on educational outcomes (Levy, Owens, and Sampson 2019; Wodtke et al. 2016) as well as to assess the mediating mechanisms through which neighbourhoods might exert their effects, from school quality (Wodtke et al., 2023) to exposure to environmental hazards (Wodtke, 2022).

2.3.1. Experimental and quasi-experimental studies

A different response to neighbourhood methodological challenges, and especially to selection concerns, has been the exploitation of controlled or natural experiments, primarily in the United States. To tackle issues of selection, experimental and quasi-experimental studies are indeed generally considered as the gold standard to reduce bias and isolating causal effects (Cook et al. 2002). Different types of strategies have been deployed, often involving a random allocation of low-income families from one neighbourhood context to another. By excluding individuals' ability to choose where to live, authors are able to more clearly disentangle whether differences in certain outcomes are driven by the neighbourhoods themselves rather than by differences in

the characteristics of individuals who live in different types of neighbourhoods (Harding et al., 2010).

The most notorious among the experimental programs is the Moving to Opportunity (MTO) experiment (Goering and Feins, 2003 ; Orr et al., 2003 ; Kling et al., 2007 ; Briggs et al., 2010; Sampson, 2008 ; Ludwig et al., 2008 ; Clampet-Lundquist and Massey, 2008). Taking place from the 1990s and still ongoing, the MTO was set in five communities in the US, Baltimore, Boston, Chicago, Los Angeles, and New York. The study realized a randomized draw within the most disadvantaged neighbourhoods, moving low-income families to the private housing market in less deprived areas. The aim is to measure the impact over time of how moving to a less disadvantaged neighbourhood might affect cognitive skills, educational, economic as well as health outcomes. Overall, the MTO was developed with the intention to provide the most compelling test of the effects of neighbourhood poverty, although it ended up with reporting conflicting findings, thus evidencing the need to evaluate more carefully the specific and different conditions under which neighbourhoods matter (Small and Feldman, 2012).

Other programs also exist, which are similar to the MTO but quasi-experimental in nature, since they lack the formal random assignment of families to neighbourhoods. Examples are the Gautreaux Program, the Mount Laurel, and the Yonkers Project. These resulted either from large scale policies of urban renewal projects, or from court battles over public or affordable housing (Casciano & Massey 2012, Fauth et al. 2007, Rubinowitz & Rosenbaum 2000). The Gautreaux program took place in Chicago in the late 1970s and has been used to study mainly the economic consequences of living in neighbourhoods characterized by different socio-economic characteristics (Mendendhall et al., 2006; Rosenbaum and DeLuca, 2000). The program involved the relocation of a sample of low-income blacks to a very different set of neighbourhoods, poor or less poor, more or less racially integrated, thus ranging from middle-income white suburbs to low-income, mostly black, urban areas. Similarly, the Yonkers project involves low-income and ethnic minority families moving to middle-class white neighbourhoods based on a lottery program and studies the consequences on a number of outcomes such as problem behaviour, well-being and educational outcomes (see for example Fauth et al., 2007). The Mt. Laurel project took place in New Jersey and compared the experiences of residents living in an affordable housing project in a middle-class suburb to a comparable group of non-residents (Massey and Casciano, 2012). Other quasi-experimental strategies include public housing demolition and revitalization programs (Chyn, 2018, Jacob 2004; Clampet-Lundquist 2007) such as the famous HOPE VI (Popkin et al., 2004; Curley,

2010), inclusionary zoning mandates (Casciano and Massey 2012), and public or social housing allocation (Ludwig et al. 2011; Galster and Santiago, 2015; Galster, Santiago, and Stack 2016; Glaster and Santiago, 2017).

2.3.2. A focus on the allocation policy of social housing in the UK

In two empirical chapters of this thesis, Chapter 3 and Chapter 5, similar to previous authors, I exploit the quasi-exogenous nature of the social housing allocation process in the UK as an empirical strategy. In many countries, the allocation of public or social housing units can be assumed as quasi-random. When applying for a public housing unit, individuals usually enter a waiting list, and they are unable to provide geographical preferences concerning their residential location. Moreover, studies also rely on that idea that the availability of public housing is geographically diverse, so that units are located in a wide range of neighbourhoods, more or less disadvantaged. Galster and Santiago (2017), for example, use such empirical approach to assess youth and adult educational, employment and fertility outcomes in the US. Such a strategy has also been intensively exploited also in the UK (Weinhardt, 2010; Weinhardt, 2014; Patacchini and Zenou 2011; Fumagalli and Fumagalli 2019; Propper et al. 2007), France (Algan et al., 2016; Sari, 2012; Goux and Maurin, 2007) and European Nordic countries (Billings at el., 2022).

The next paragraph presents in detail the institutional setting that justify my methodological choice as well as tests some of its assumptions.

Institutional Background

I rely on the quasi-exogenous nature of the social housing allocation process in the UK from the 1958 up to the 1970s to ensure my findings are robust. To obtain a social housing unit in the UK, all individuals had to go through this legally regulated allocation process.

In Great Britain at the time, a big part of the population, of a mixed social background, used or planned to live in council housing accommodations (Boughton, 2018). In fact, in the 1970s the social housing stock was still considered as above-average quality accommodation (Weinhardt, 2014), with most houses having gardens and good amenities. Hence, in 1974, 25% of the UK population and 35% of the NCDS sample lived in social housing (Lupton et al., 2009). In the mid-1970s, the median income of council tenants was 73% that of home owners, a proportion that dramatically fell to 43% by the mid-1980s. Things started to change indeed with the introduction in 1977 of The Housing (Homeless Persons) Act. The act gave local

authorities a duty to house vulnerable households facing immediate lack of housing, progressively transforming council housing from a 'gold standard of accommodation', to a symbol of segregation (Mulrenan, 2019). In other words, for those born after 1970, there is a strong correlation between renting from a social landlord and social disadvantage (Feinstein et al., 2008).

Throughout the period of interest, instead, local authorities (districts) used a waiting list system (Van Ham and Manley, 2009) to allocate social housing applicants to housing units across all the lower-level local neighbourhoods within their boundaries, including socio-economically better-off areas. This meant that applicants had very limited discretionary choice over where precisely, within the larger local authority territory, they would end up living (Algan et al., 2016). The system of allocation was conceived to be property-led rather than applicant-led (Pawson and Kintrea, 2002), it was overly bureaucratic, lacked transparency and did not reflect the needs and preferences of the tenant as priorities (Clapham and Kintrea, 1991). In fact, the lack of rigour, standard and guidelines with respect to how the allocation process was carried out meant that the allocation proceeded merely by date order, rather than according to need-based criteria (Patacchini and Zenou, 2011; Greenhalgh and Moss, 2009)[1]. The vast number of requests, significantly higher than the available housing stock, contributed to the fact that no consideration was given to prospective tenants' preferences (Patacchini and Zenou, 2011).

When at the top of the queue, prospective applicants received the first available offer (Regan and Patrick, 2001). Refusal to accept an offer of accommodation was associated with a severe penalty (e.g., suspension from the waiting list for a long period of time) and, therefore, rarely happened in practice. Although in more recent years, after the introduction of the Choice Based Letting policy in 2001, more space for preferences has been granted to prospective tenants, refusing an offer is still not common. Regan et al. (2001) writes that one of their interviewees in Reading who rents from a social landlord complained: "*Most of the people I know who have been offered flats or houses or anything have no choice… it is that or nothing*" (2001, p.22). Moreover, rents for social housing were cheaper than rents in the private sector, resulting in turnover being very low and increasing waiting list time. The fact that the waiting lists were becoming excessively long was indeed one of the reasons for which the system started being revised from the 1980s onwards (Fumagalli and Fumagalli, 2019).

[1] Although there was some minor flexibility to advance cases on the waiting list on the basis of some specific social (or medical) reasons.

All this considered, this work relies on the assumption that going through the social housing allocation process reduces individuals' discretion in the choice of where to live and, thus, limits the endogenous sorting into neighbourhoods. In order to assess the validity of this assumption, I additionally perform a number of empirical analyses presented below.

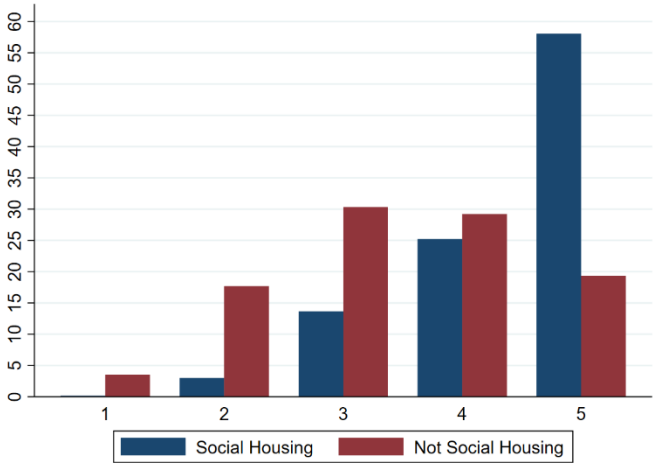
Testing social housing allocation assumptions

In the following, I empirically validate the extent to which the quasi-random assumption of the social housing policy holds. I perform, in particular, three separate analyses.

An important assumption behind this work is that social housing tenants are distributed across neighbourhoods characterised by different levels of deprivation. One way to measure the spatial evenness of social renting is by measuring the index of dissimilarity (D). A D value of 0 would indicate that social renting households are spread equally across LSOAs (for example, in all LSOAs 25% of households are social renting). A D value of 1 suggests that all LSOAs have either 0% or 100% social renting households. According to Lloyd and Gleeson (2018), in 1971, the index of dissimilarity amounted to 0.56, which can be interpreted as moderate segregation (Massey and Denton, 1993, p. 20).

In Figure 2.2, I show results from the entire NCDS sample (N=9,147) concerning the distribution of social housing tenants versus people residing in different tenures by neighbourhood deprivation to provide evidence of the fact that social housing tenants are distributed across neighbourhoods characterised by different levels of deprivation. In 1971, the majority of social tenants live in the most deprived population quintile, as compared to 20% of individuals who are not in social housing and that live in the most deprived quintile. While in the 3rd and 4th quintiles the difference is narrower, at the bottom of the distribution (1st and 2nd quintile) we find less than 5% of people living in social housing but more than 20% of those not living in social housing. It must be noted that very few households reside in the least deprived population quintile overall (less than 5%) and none of them is in social housing. Although I clearly see that the two distributions are not the same, there is still variation in the level of deprivation to which individuals in social housing are exposed in the sample. More than 15% of them, indeed, lives in the three least deprived quintiles and around 45% does not live in the most deprived quintile.

Figure 2.2. Distribution of social and non-social housing tenants across population quintiles



Notes: elaboration upon the author. NCDS Data, Sweep 3. Not social housing includes home owners, private renters, and other tenures.

In a second step, I look at the correlation between neighbourhood deprivation and individuals characteristics. An important test for the identifying assumption of this strategy is that the allocation of council tenants to neighbourhoods is unrelated to the tenants' characteristics. The underneath hypothesis is that the relationship between tenants' and neighbourhood's characteristics is stronger for the full sample (which includes all tenure-types), than for social housing sample, who have less chance to self-select into their neighbourhood of choice.

Since I build upon the quasi-experimental nature of the social housing strategy in in two of the empirical chapters within this dissertation (Chapter 3 and Chapter 5), I perform the same tests for both samples. Information on the operationalisation of the relevant variables are included in each the dedicated chapter. For consistency purposes, all upcoming analyses are here showcased in such a way that a greater value of the neighbourhood variables corresponds to greater deprivation.

With reference to the sample in Chapter 3, I investigate the relationship between neighbourhood deprivation (Townsend score) and three relevant variables I include within the analysis: a proxy measure for family poverty, parental education and father social class. Table 2.3 reports pairwise correlations for the social housing subsample.

Table 2.3. Bivariate correlations between key variables of Chapter 3 in the social housing subsample: Townsend score, polygenic score, parental educational and school quality.

	Townsend Score	Family Poverty	Parental Education	Household Social Class
Townsend Score	1.000			
Family Poverty	- 0.017	1.000		
Parental Education	- 0.065**	0.003	1.000	
Father Social Class	- 0.063**	- 0.156***	0.109***	1.000

Note: Data: NCDS, Sweep 3 *** p<0.001, ** p<0.01, * p<0.05 Neighbourhood deprivation negatively coded (higher values meaning higher deprivation); family poverty, parental education and father social class positively coded (higher values meaning lower poverty, higher education and higher social class).

The correlation between deprivation and family poverty is almost equal to 0 and does not reach statistical significance. The correlations between neighbourhood deprivation and, respectively, parental education and father social class are statistically significant (p<0.01). However, the size of correlation coefficient in both cases is very low and almost equal to 0 (-0.06). In Table 2.4 below, the same analysis is performed, but on the full sample. Here we observe a greater and statistically significant correlation (-0.12, p<0.001) between family poverty and the deprivation score. The correlation between the Townsend score and parental education as well as social class is also highly statistically significant and, with respect to the size, much greater in this sample than in the social housing sample (respectively, 0.25 and 0.32).

Table 2.4. Bivariate correlations between key variables of Chapter 3 in the full sample: Townsend score, polygenic score, parental educational and school quality.

	Townsend Score	Family Poverty	Parental Education	Social Class
Townsend Score	1.000			
Family Poverty	- 0.126***	1.000		
Parental Education	- 0.256***	0.092***	1.000	
Social Class	- 0.324***	- 0.168***	0.4***	1.000

Note: Data: NCDS, Sweep 3 *** p<0.001, ** p<0.01, * p<0.05 Neighbourhood deprivation negatively coded (higher values meaning higher deprivation); family poverty, parental education and father social class positively coded (higher values meaning lower poverty, higher education and higher social class).

I perform the same analysis, in reference to the sample analysed in Chapter 5. Table 2.5 depicts the bivariate empirical correlation matrix between neighbourhood deprivation and three relevant variables I include within the estimation: a measure of individual genetic endowment (Polygenic score), parental education and school quality.

Table 2.5. Bivariate correlations between key variables of Chapter 5 in the social housing subsample: Townsend score, polygenic score, parental educational and school quality.

	Townsend Score	Polygenic score	Parental Education	School Quality
Townsend Score	1.000			
Polygenic score	0.055	1.000		
Parental Education	- 0.076*	- 0.002	1.000	
School Quality	- 0.259***	- 0.067*	- 0.051	1.000

Note: Data: NCDS, Sweep 3 *** p<0.001, ** p<0.01, * p<0.05. Neighbourhood deprivation negatively coded (higher values meaning higher deprivation); polygenic score, parental education and school quality coded (higher values meaning higher genetic endowment, higher education and higher quality).

Whilst the correlation between neighbourhoods and school quality is moderate (- 0.26) since those are nested in the neighbourhoods, the correlations with family SES (- 0.07) is noticeably small, whilst significantly distinguishable from zero at the p<0.05 level. The correlation between the neighbourhood index and youth's polygenic score (0.05) is not statistically significant. Table 2.6 displays the same bivariate correlations among all constructs of interests for the full sample.

Table 2.6. Bivariate correlations between key variables of Chapter 5 in the full sample: Townsend score, polygenic score, parental educational and school quality.

	Townsend Score	Polygenic score	Parental Education	School Quality
Townsend Score	1.000			
Polygenic score	- 0.097***	1.000		
Parental Education	- 0.242***	- 0.126***	1.000	
School Quality	- 0.398***	- 0.162***	- 0.201***	1.000

Note: Data: NCDS, Sweep 3 *** p<0.001, ** p<0.01, * p<0.05. Neighbourhood deprivation negatively coded (higher values meaning higher deprivation); polygenic score, parental education and school quality coded (higher values meaning higher genetic endowment, higher education and higher quality).

Results point to a much stronger correlation between the neighbourhood deprivation index and, respectively, individuals' polygenic score (- 0.097), family SES (- 0.24) and school quality (- 0.39), all significant at p<0.001.

Overall, across both samples, results confirm that the relationship between tenants' and neighbourhood's characteristics is stronger for the full sample than for social housing sample, which provides some support for the fact that members of the social housing group have less chance to self-select into their neighbourhood of choice.

The final test I perform consists in comparing how statistically different are the distribution, with respect to a set of relevant variables, in the least and most deprived neighbourhood quintiles of, respectively the full and social housing sample. The logic behind

this test is that, building on the assumption that individuals in the social housing sample are more limited in the choice of where to live, in this group there should be greater homogeneity between the two quintiles than in the full sample.

Table 2.7 showcases results for the sample analysed in Chapter 3. I compare how different are the distribution of family poverty, parental education and social class in the two opposite neighbourhood quintiles. The null hypothesis is that there is no difference between the two distributions. I observe that the difference between mean values in family poverty between the two quintiles is non-significant in the social housing sample, while it is statistically significant in the full sample. The difference concerning parental education and social class is statistically significant for both samples. However, we can obtain some additional insights by comparing statistics obtained from the social housing sample with the same ones computed for the full one. Even if there is some variability in the social housing sample among neighbourhood quintiles, this seems indeed to much more limited than in the full sample. In fact, smaller t-values indicates that the groups are similar while a larger t-value that the groups are different. In the full sample, we observe that t-values tend to be significantly bigger as compared to the social housing sample (-9.67 vs. -3.146 for parental education and -13.869 vs. -2.635 concerning social class).

Table 2.7. *t*-test for Equality of Means for full and social housing sample, and most and least deprived neighbourhood quintile

	Full Sample			Social Housing Sample		
VARIABLES	Q1	Q5	*t*-test	Q1	Q5	*t*-test
Family Poverty	0.93	-0.98	-4.663***	0.88	0.89	ns
	(0.01)	(0.004)		(0.017)	(0.015)	
Parental Education	0.651	1.023	-9.670***	0.351	0.467	-3.146**
	(0.027)	(0.027)		(0.025)	(0.026)	
Social Class	2.283	3.277	-13.869***	1.771	1.96	-2.635**
	(0.052)	(0.049)		(0.053)	(0.05)	

Note: Data: NCDS, *** p<0.001, ** p<0.01, * p<0.05. Q1 represents the least deprived neighbourhood quintile, Q5 is the most deprived neighbourhood quintile.

In Table 2.8 I perform the same t-test but in reference to Chapter 5. I compare how different are the distribution of the polygenic score, parental and school characteristics.

Table 2.8. *t*-test for Equality of Means for full and social housing sample, and most and least deprived neighbourhood quintile

	Full Sample			Social Housing Sample		
VARIABLES	Q1	Q5	*t*-test	Q1	Q5	*t*-test
Polygenic Score	0.23	-0.07	-4.616***	0.032	0.18	ns
	(0.047)	(0.045)		(0.068)	(0.074)	
Parental Education	0.766	0.427	-11.689***	0.475	0.0382	ns
	(0.019)	(0.021)		(0.035)	(0.033)	
School Quality	2.329	1.382	-20.428***	1.851	1.311	-7.6753***
	(0.036)	(0.028)		(0.056)	(0.042)	

Note: Data: NCDS, *** p<0.001, ** p<0.01, * p<0.05. Q1 represents the least deprived neighbourhood quintile, Q5 is the most deprived neighbourhood quintile.

The difference between mean values in both PGS and family SES is non-significant in the social housing sample, while it is highly statistically significant in the full sample. Nonetheless, the difference concerning school quality is significant for both samples but, as previously mentioned, it is important to note that schools and neighbourhood context might be more strictly interrelated.

Altogether, these analyses confirm the expectations. Although not perfect, the residential quasi-randomisation of social hosing seems to be satisfactory, providing evidence of the fact that, as compared to the full sample, the social housing sample is characterise by a much lower homogeneity as well as correlation between individual and neighbourhood characteristics.

2.4. Qualitative evidence

By employing in-depth fieldwork, participant observation, and interviews, qualitative studies have also provided valuable insights into the social dynamics, spatial arrangements, and cultural processes that shape urban and neighbourhood environments, influencing the lives of their inhabitants. Wilson's work (1978) used quantitative and qualitative means to highlight the complex interactions between social structures and individual agency. Since then, ethnographic research has represented an important strategy to better understand the interactions between individuals and their urban surroundings.

In a comprehensive review, Newman and Massengill (2016) detail the contributions of qualitative studies to neighbourhood research. Most of these works have been carried out in the US, and often, like Wilson's work, in Chicago (Duneier, 1992; Pattillo-McCoy, 1999 ; Venkatesh, 2000 ; Klinenberg, 2002).

Qualitative insights have been a critical element to inform the theorised mechanisms through which the neighbourhood environment is likely to affect individual outcomes. Such insights have been fundamental to understand the roots of social isolation characterising individuals living poor areas (Wilson, 1987; Klinenberg, 2002) as well as the link between jobless, unemployment, crime and the development of cycles of neighbourhood poverty, that individuals often fail to escape (Edin et al., 2001; Levitt & Venkatesh 2000, Scott 2004). In the UK in particular, Lupton's (2003) comparative study of 12 impoverished communities in England and Wales effectively exemplifies this perspective. During the nineteenth century, these blighted areas were predominantly inhabited by working-class communities heavily reliant on a single industry, such as shipping in Liverpool, mining in Wales, and metal manufacturing in Birmingham. However, with the decline of these industries, the public housing complexes initially built to accommodate the workers descended into economic hardship. Lupton's in-depth account (2003) demonstrates that even though the residents of these communities receive government assistance to sustain their housing, they withdraw from school, political involvement, and communal activities.

Overall, many of these ethnographic studies have the merit to deep delve into the reasons for which exposure to neighbourhood poverty might affect different residents differently, providing interesting insights to the neighbourhood effect heterogeneity discourse. Family management practices, for example, are a key element that shapes the extent to which youth might be able to avoid the negative consequences of growing up in more deprived areas (Fustenberg et al., 1999), as are individuals' own perception of the neighbourhood environment (Small, 2004) and their own orientation towards family versus friends and acquaintances (Briggs et al., 2010).

Although such works have depicted a comprehensive, yet complex, picture of how neighbourhood disadvantage might influence youth development, these insights have not been fully integrated with quantitative works testing specific hypotheses of neighbourhood effects (Small and Feldman, 2012). Rather, qualitative findings have only rarely been used to interpret findings from large-scale experimental and quantitative studies. An exception are the works carried out by some authors working on the MTO (Clampet-Lundquist et al., 2011; Popkin et al., 2008; Briggs et al., 2010; DeLuca et al., 2011) or HOPE VI (Curley, 2010) programs. By leveraging in-depth interviews, scholars have been able to disentangle some of the reasons behind the null, unexpected, or conflicting findings (Burdick-Will et al, 2011; Briggs et al., 2010). For example, they have unveiled how some of the experimental families faced structural barriers and hold specific beliefs and constraints, which were not considered within quantitative

studies but that concretely hindered those families' ability to genuinely relocate to high-opportunity neighbourhoods, or to utilise the higher quality services available in those communities. Moreover, such qualitative studies helped to tease out potential reasons for gender-differences in some of the main observed effects (Clampet-Lundquist et al., 2006; Popkin et al., 2008). Namely, providing additional evidence as for how neighbourhood institutions and public spaces significantly shaped attitudes towards place attachment, individuals' own encounters within the neighbourhood, and resulting social capital dynamics (Curley, 2010).

Chapter 3

Gendered contexts? The effect of neighbourhood socio-economic deprivation on girls' and boys' cognitive and non-cognitive development

Introduction

Since the work of Wilson (1987), the literature on neighbourhood effects has become increasingly rich, with authors having intensively explored how living in a more or less deprived residential context affect adolescents' outcomes, including educational achievement, cognitive skills and problem behaviour (Leventhal and Brooks-Gunn, 2000; Sharkey and Faber, 2014). Nonetheless, authors have recently stressed that neighbourhood studies still need to better investigate, among other things, *for whom* neighbourhoods matter (Levy, 2019; Small and Feldman, 2012).

Gender is a crucial source of heterogeneity when it comes to adolescent development (Perry and Pauletti, 2011). The residential environment may differently affect males and females, but evidence on this has so far been inconclusive and almost exclusively assessed in the United States. Some authors have suggested that, due to their greater time spent outside, young males might be more severely affected (Entwisle et al., 1994; Clumpet-Lundquist et al., 2011). Other scholars have stressed instead how disadvantaged neighbourhoods may represent more challenging environments for women, because they are characterised by a higher likelihood of harassment (Popkin et al., 2008; Nguyen et al., 2015) or they fail to provide the support from institutions and people in the neighbourhood that girls, as compared to boys, are more used to leverage (Plybon et al., 2003).

In this chapter, I try to shed additional light on this question. I build upon previous research aimed at assessing the heterogeneous effect of the residential environment during adolescence on a rich spectrum of cognitive and non-cognitive skills, and I focus specifically on the existence of differentials in outcomes between young girls and boys.

I assess the existence of neighbourhood effects on both cognitive skills as well as four different non-cognitive dimensions. These span from the more commonly studied behavioural problem dimensions, to the less investigated academic motivation and employability skills (Farkas, 2003). I argue that the four of them are to be considered in a continuous way. They do represent a wide range of characteristics all identified as crucial to individual success. I am therefore able to be as comprehensive, but also as more detailed, as possible with regard to the developmental aspects that matter for education.

I use data from the UK National Child Development Study (NCDS). As described in Chapter 2, in addition to the full sample, I focus on adolescents growing up in social housing in order to ensure findings are robust to one of the main methodological issues in the

neighbourhood effects literature, endogeneity related to neighbourhood selection (Manski, 1993; Dietz, 2002).

In sum, this chapter aims at making four main contributions. First, it highlights the "gendered" nature of neighbourhood effects, by building on the existing research mostly framed within the US context. Second, it enriches the spectrum of (non-cognitive) outcomes typically studied in this field, by focusing on the relatively understudied dimensions of academic motivation and employability skills. Third, it adds to the limited non-observational literature assessing the role of the residential neighbourhood in the UK, by exploiting the quasi-experimental nature of the social housing allocation process. Finally, based upon descriptive statistics, it provides a thorough discussion of the mechanisms behind the differential, gender-based, neighbourhood effect I find on the different outcomes.

3.1. Theoretical and Empirical Background

3.1.1. Neighbourhood deprivation and skills development

Theoretically, authors have posited a variety of theories for which the neighbourhood where growing up matters, Among these, described in Chapter 2, a prominent perspective looks at socialisation and social interaction, which emphasises the importance of peers and social networks, that can provide better access to resources, support systems, and opportunities for residents, and that available within a neighbourhood. Moreover, the theory of social disorganization posits that neighbourhoods with high levels of poverty, residential instability, and social fragmentation can lead to reduced collective efficacy and overall worst outcomes for resident youth (Sampson and Groves, 1989). Other theories suggest that neighbourhood characteristics, such as the availability of quality schools, good public spaces, and efficient public services can shape individual outcomes (Small and Newman, 2001). In Chapter 2, I also review prior empirical literature on the relationship between neighbourhood deprivation and cognitive and non-cognitive outcomes. While previous work on the role of the residential environment on cognitive skills tends to be mixed, with some authors failing to find significant effects, there is greater convergence on a positive association between neighbourhood socio-economic deprivation and internalising and externalising dimensions of problem behaviour. Concerning academic motivation and employability skills, there is no strong available evidence.

Overall, based on the review of theory and evidence provided in Chapter 2, my first hypothesis is:

Hypothesis 1: neighbourhood deprivation is negatively associated with cognitive and non-cognitive outcomes.

3.1.2. A gendered approach to neighbourhood research

While the theoretical focus on exploring the heterogeneity in neighbourhood effects is only at its beginning, some dimensions have been explored significantly more than others, as authors have tried to unpack the extent to which individual and family characteristics affect how neighbourhoods shape individual outcomes. Individual socio-demographic characteristics, and gender in particular, are among the ones that have received more attention.

The fact that gender is an important dimension for neighbourhood dynamics has been known for a long time. Early works analysing the effect of neighbourhood characteristics such as poverty and unemployment on educational attainment found heterogeneity based on gender in how strong these neighbourhood measures affected the outcomes (Corcoran, 1995; Duncan, 1994). Using data from the US, Aaronson (1998) found that neighbourhood disadvantage reduced college enrolment but using the same data, although only focusing on sisters, Plotnick and Hoffman (1999) comes to a different conclusion. They argue indeed for the correlation among neighbourhood characteristics and educational outcome to be driven in most part by family characteristics. Such inconclusiveness emphasises the potential and critical role played by gender in affecting the relationship between neighbourhood characteristics and individual outcomes.

Theoretically speaking, a number of mechanisms are to be discussed as for which males and females might be differently affected by their residential areas. Based on that, being a male or a female can be perhaps be perceived as a specific form of individual advantage or disadvantage, and assessed in combination with neighbourhood advantaged or disadvantaged conditions.

According to a first perspective, "male" youth are in a condition of relative disadvantage, as compared to being "female". Such consideration relates to how adolescents girls and boys *spatially* experience their neighbourhood in a different manner. Interviews with 86 teenagers from Moving To Opportunity families in the Baltimore and Chicago sites revealed indeed that boys were more likely to hang out in the neighbourhood, often by playing sport, much more and for longer times than girls (Clampet-Lundquist, Edin, Kling, & Duncan, 2011). Girls, instead, declared to be more likely to spend time inside or to prefer to use public spaces such as malls or movies as alternatives to hanging out in a neighbourhood. Relying on these

premises, research looking at gender and neighbourhood effects has posited that boys, as compared to girls, are perceived to be more at disadvantage than females, since they are more likely to be negatively affected by residing in a deprived area due to their higher exposure to the surrounding environment. Neighbourhood quality, and in particular the level of crime and violence, are indeed relevant predictors of drop-out rate (Connell, Clifford, and Crichlow 1992) and achievement (Spencer, 1992; Duncan and Laren 1990; Brooks-Gunn, Duncan, and Kato, 1991) for boys, but not girls. At the same time, however, citing Bing (1963) Entwisle et al. (1994) argue that, as mothers provide boys with more freedom and more opportunity to explore their own surroundings, they become able to develop greater problem solving, spatial and numerical ability than girls.

Research has also highlighted the gender-segregated nature of the informal labour market in poor neighbourhoods, which may account for boys' and girls' different spatial trajectories (Clampet-Lundquist, 2013). In highly deprived areas, the desire to contribute with expenses can easily push youth into the illegal economy. Qualitative evidence (Clampet-Lundquist, 2013) has shown that, in the quest for informal work, males are much more likely to engage in illegal activities such as drug-trafficking than females who are, instead, more likely to babysit or "do hair", with significant implications in terms of exposure to the neighbourhood area. Considering the effects of such dynamics on adult economic outcomes, Chetty and Hendren (2018) find that growing up in areas with high concentration of urban poverty reduce income by 27.9% for boys relative to the mean, but only 5.4% for girls, with one explanation being that males in these areas are particularly likely to be incarcerated.

Based upon these theories, as a relative position of disadvantage might be experienced by boys, due to their more intense exposure to neighbourhood poverty and crime, I hypothesis that:

Hypothesis 2a: the effect of neighbourhood deprivation on cognitive and non-cognitive outcomes is stronger for boys than girls.

Nonetheless, over time a much more complex picture has emerged, often contradicting the spatial argument above and pointing to "girls" as the ones experiencing a position of relative disadvantage in the way they result to be affected by neighbourhood characteristics (Gibbons, Silva, & Weinhardt, 2013).

Comprehensive research based on experimental studies in the US has found that moving into a less deprived residential area had more positive effects on female children than on male children on a range of outcomes during adolescence such as mental health, physical health, risky behaviours,and educational outcomes (Odgers et al. 2015; Kessler et al. 2014; Kling et

al., 2005; Kling et al., 2007, Kessler et al., 2014). However, some studies fail to find significant gender effects (Chetty et al., 2016; Nieuwenhuis, et al., 2017) and others found evidence of the opposite (Leventhal and Brooks-Gunn, 2003; Leventhal and Brooks-Gunn, 2004). Overall, low-income girls have been found to react more positively than boys more from moving to affluent areas due, among other things, to a significant decrease of arrest rates (Kling et al, 2005), in contrast to boys who showed instead increased behavioural problems (Sanbonmatsu et al, 2006). To explain this, Oberwittler (2007) emphasises how, particularly in the most disadvantaged neighbourhoods, adolescents seem to be divided into those with higher aspirations and more dissatisfied with their neighbourhood and those with lower aspirations who enjoy their social environment and spend most time together with their local friends. Girls from the MTO experiment who did move to less deprived areas were more likely than boys to withdraw from their neighbourhood peers altogether, choosing instead to forge friendships at school or at work (Clampet-Lundquist, Edin, Kling, & Duncan, 2011), with consequences on the places in which they opted to spend more time in (DuBois & Hirsch, 1990). In contrast, boys moving to more affluent areas where more likely than females to remain in contact with delinquent peers and they also were less likely to develop "survival strategies" for high-poverty neighbourhoods, which could prove important if they – as many did – return to disadvantaged residential contexts afterwards (Clampet-Lundquist et al 2011). Overall, this suggests that, when given the opportunity of being embedded in a better neighbourhood environment, girls may benefit more than boys. On the other side of the coin, this also signals a potential greater dissatisfaction experienced by females, as compared to males, living in socio-economically deprived areas suggesting that this group of individuals might suffer the most the consequences of residential deprivation.

The literature on neighbourhood collective efficacy stresses, for example, that girls are the ones more at risk for violence and sexual harassment, especially in adolescence, and thus bear most of the consequences of social disorder in the residential area (Galster et al., 2010; Popkin et al., 2008). Neighbourhood deprivation has indeed consistently been associated with earlier timing of the first sexual intercourse and more at-risk sexual behaviour (Browning et al., 2005), with cascading effects on both educational and behavioural outcomes (Crane, 1991). Typically, girls tend to be more monitored than boys by parents as well as by members of the neighbourhood community (Kim, Hetherington,, & Reiss, 1999). However, neighbourhoods characterised by high deprivation may involve a lack of such forms of monitoring, which in non-deprived neighbourhoods would normally buffer girls from exposure to negative influences and thus be more detrimental for them. Hence, while growing up, girls in

disadvantaged areas are increasingly more vulnerable to neighbourhood risk factors associated with social disorganization (Kroneman, Loeber, & Hipwell, 2004).

In addition to that, a greater availability of role models as well as the presence of a network of support and encouragement seems critical for sustaining girls' cognitive performance, academic motivation and aspirations (Goodenow & Grady, 1993). Girls as they are indeed significantly more likely than boys to leverage the support that role models and older people in the neighbourhood can provide them with (Plybon, Edwards, Butler, Belgrave, & Allison, 2003). This holds especially for girls from low-income families, because adolescents with poor parents must rely more heavily on resident adults and neighbourhood institutions (Wodtke, Elwert, & Harding, 2016). In early adolescence in particular, when gender role norms are particularly strong, girls may also feel pressure to adopt stereotypically feminine and passive behaviours rather than to pursue academic work with any vigour. In a study about the experience and expectations about talking styles in classroom of British adolescents, Michelle Stanworth (1983) find that teachers encourage boys to be assertive and vocal in classroom interactions, and such forms of behaviour were vastly appreciated by girls. On the contrary, girls were not encouraged to demonstrate the same abilities and, when they did, the other girls in the class were to heap scorn on them. Similarly, authors found evidence for a marked gender stereotyping of occupational careers for boys and girls. In a study about the occupational expectations of adolescents, Dowan and Adelson (1966) stress that 95% of girls' occupational choices fell into the categories of personal aide, social aide, white collar traditional and glamor fashion. Similarly, Schlossberg and Goodman (1972) provide a detailed account of youth gender stereotyping on occupation, confirming that both children and adolescents perceive women to be limited to perform certain specific occupation, whereas men were not. They highlight in particular the importance of role models in the development of such gendered and stereotyped identities. Comparing the answers from adolescents going to a middle-income school vs. a model city school set in a more deprived areas, the former were consistently less stereotyped, in terms of occupational aspirations, than the latter. Whereas middle income students were indeed embedded in a community where many of the mothers worked at professional jobs, the model city school was set in a community where women were working almost exclusively at low-level, women's jobs. Finally, school quality is also strongly associated with girls' educational aspirations (Gibbons, 2002) and with better school grades (Ali, Ullah, & Shah, 2020). There is also vast evidence of the fact that girls tend to have stronger attachment to school and to display higher school belonging (Goodenow & Grady, 1993), which are considerable predictor of academic motivation and cognitive performance. Hence, living in

more deprived neighbourhoods, where gender stereotypes are stronger, forms of support and role models are deficient as compared to less deprived areas and the quality of institutions is lower (Parrish, Matsumoto, & Fowler, 1995) can be more detrimental for girls with respect to boys.

Due to the possible several reasons discussed above, it is thus possible that being a young female, within the context of more deprived area, may represent an individual source of disadvantage. Based on that, I formulate an alternative hypothesis:

Hypothesis 2b: the effect of neighbourhood deprivation on cognitive and non-cognitive outcomes is stronger for girls than boys.

3.2. Data and Methods

While the nature of the NCDS is that of a longitudinal study (see Chapter 2), in this work I leverage information from Sweep 3.

The initial sample size, composed of all individuals who responded to sweep 3, is composed of 14,645 individuals. As I match individual information from the main NCDS dataset with data about the deprivation of their residential neighbourhood, I retain individuals for which neighbourhood information is available (N=11,303). Second, I include only those individuals who have a non-missing value on all the dependent variables (N=7,973). The subsample of individuals living in social housing to limit endogeneity issues related to neighbourhood sorting is composed by N=2,518 individuals. A final additional consideration regards exposure time, a key variable in neighbourhood effects research (Chetty et al., 2016). I require subjects in my final sample to have lived in the same place for at least 5 years, as I deem it important to consider a long period to have enough exposure to the neighbourhood environment. However, I also carry out separately a robustness check testing the sensitivity of results to this exposure threshold. The full and social housing final samples size are composed of, respectively, N=4,906 (2,444 are males; 2,462 are females) and N=1,958 (952 male; 1006 female) individual observations.

3.2.1. Measures

Cognitive and non-cognitive outcomes. In this empirical chapter, I focus on cognitive and four different non-cognitive outcomes (academic motivation, employability skills, internalising and externalising behaviour). I include these four different non-cognitive dimensions for two main reasons. First, some non-cognitive dimensions, namely academic motivation and employability

skills, have been so far under-researched in the broad neighbourhood literature and, thanks to the data, I have here the chance to make up for this research gap. Second, as each of these outcomes has a slightly different nature, it also has a different relationship with the cognitive dimension. As previously noted, the line between the cognitive and non-cognitive dimensions is far from being clear. Authors have suggested that a strong relationship exists between academic motivation and positive psychosocial characteristics and cognitive abilities (Green et al., 2006), while problem behaviour dimensions have been more widely associated to mental health conditions and disorders (McLeod and Fettes, 2007). Overall, while I will refer to cognitive and non-cognitive indicators below, the measurements I use are to be considered in a more continuous way as representing a wide range of skills that have been identified as crucial to individual success.

Since NCDS data contain a wide range of measurements relating to these dimensions, to make the most out of the richness provided by the dataset I exploit data reduction techniques, Principal Components and Factor Analysis, to operationalise cognitive and non-cognitive outcomes.

Cognitive skills. As a measure of cognitive skills at age 16, a Principal Components Analysis (PCA) was run on the two main cognitive-related available variables, measuring respectively reading and math ability. Scores from the first unrotated component extracted were saved, thus providing a measure of each child's cognitive ability.

Academic motivation. Academic motivation, which refers to both academic perseverance and having an academic mind-set. Academic perseverance has often been associated with the idea of grit (Duckworth & Gross, 2014), effort and task persistence (Farrington et al., 2012). Having an academic mind-set additionally refers to one's beliefs about the relationship between oneself and academic work, and thus relates to concepts such as self-efficacy (Bandura, 1977). To operationalise it, I created an academic motivation score by performing a confirmatory factor analysis on eight items related to conscientious school and work habits (i.e. no truancy; effort) using the lavaan package in R.

Employability skills. I define employability skills building upon Farkas (2003)' influential interpretation of non-cognitive skills as the set of traits and behaviours that accrue rewards in the labour market. In his seminal review, he configures non-cognitive skills in a comprehensive manner, including not only conscientious work and school habits, but also positive psychosocial characteristics, such as sociability, flexibility and obedience (Farkas, 2003). To operationalise employability skills, I followed Carter et al. (2019) who have built an overall indicator of employability skills based on teacher assessment and self-reported

information. This indicator is built as to be as more aligned as possible with Farkas' (2003) definition. Thus, it includes items related to conscientious school work habits, but also positive psychosocial characteristics (i.e. sociability; obedience). An overall score is derived from a second order confirmatory factor analysis using the lavaan package in R. A higher-order general factor of employability skills was constructed with lower-order teacher-reported and the self-reported factors; lower order factors were also included to capture residual covariance among items with similar content that was outside the concept of non-cognitive.

Internalising and externalising problem behaviour. Internalising and externalising problem behaviour are two renown dimensions from the psychopathological literature that involve a non-cognitive component. They refer to the extent to which individuals exhibit respectively withdrawn or anxious and aggressive or irritable behaviours. To calculate the two "externalising" and "internalising" personality dimensions at age 16, I use the items available from the Rutter scale, asked to both parents and teachers. While reliance on teacher evaluations can be problematic due to potential teachers' bias (Boring, 2017), a number of exploratory analyses has shown that teachers' reports appear to grasp much more of the personality dimensions (variability explained) than parents', thus I opt to focus on such measures. I perform first an exploratory factor analysis and, subsequently, a final second-order confirmatory factor analysis is run, grouping the items based on the factor loadings obtained in the EFA and estimating an additional overall dimension factor for problem behaviour. Factor scores are saved for internalising behaviour and externalising behaviour. The scores I obtained are increasing in problem behaviour. Thus, for greater consistency with the other dependent variables, where higher values mean higher skills/motivation, I positively recode them so that higher values indicate that there is "less of a problem".

Details around each analysis (questions, loadings, eigenvalues) are presented in Tables A1-A5 in the Appendix A.

Information on neighbourhood deprivation. In this analysis, I use the Townsend Index (Townsend et al., 1988) as a measure of neighbourhood deprivation. More information on the Index and on my definition of the neighbourhood area is included in Chapter 2. Within this chapter, I align to previous literature that studies the effect of neighbourhood disadvantage. Thus, my deprivation score is created so that higher values correspond to higher values of deprivation. I additionally standardize neighbourhood information on my sample. Overall, a negative value of the deprivation coefficient suggests that living in a more deprived neighbourhood has a negative effect on the dependent variable.

Covariates. I include in the analysis a rich set of covariates. First, two covariates that refer to the spatial dimension in which individuals are embedded: a dummy variable for whether the area is rural or urban and regional dummies. I include as individual information sex (male/female) and ethnicity (white/non-white). Moving on to parental and household characteristics, a proxy for family poverty is included, based on whether the cohort member receives or not free school meals (Jivraj et al., 2019). This is coded as a three-item categorical variable that lists whether free school meals are received, free school meals are not received and not sure/or other. Information on father social class is included, based on the five classes of the Registrar General's Social Class (Szreter, 1984). Housing tenure (only included in the full sample model) is coded as a categorical variable, which distinguishes home owners, private renters, social housing and other tenure. I introduce information on household size (1 or 2/3/4/5/6+) and on the number of siblings (no siblings/1 to 3/ 4+). Information on parental education is operationalised as the highest education obtained either by the mother or by the father and can take three possible values: low, medium or high. Two additional variables that relate to the parental and household environment for education are included. The first is whether parents are interested in child education (both parents are not so much interested/at least one parent is interested). The second is a dummy variable describing whether the child has or not a room for doing homework.

Table 3.1 contains descriptive statistics for both samples sample.

Table 3.1: Descriptive Statistics, mean(sd)

	Full Sample	Social Housing Sample	Min	Max
Cognitive Skills	0.122	-0.299	-3.843208	2.813003
	(1.221)	(1.152)		
Academic Motivation	0.010	-0.101	-2.09365	1.516607
	(0.616)	(0.614)		
Employability Skills	0.004	-0.114	-1.459354	1.106835
	(0.450)	(0.445)		
Lack of Internalising Behaviour	-0.023	-0.094	-1.591284	1.106835
	(0.381)	(0.395)		
Lack of Externalising Behaviour	-0.049	-0.182	-2.830793	.5667082
	(0.615)	(0.647)		
Neighbourhood Deprivation	1.709	3.400	-5	11
	(2.880)	(2.690)		
Rural	0.271	0.185	0	1
	(0.444)	(0.389)		
Urban	0.729	0.815	0	1
	(0.444)	(0.389)		
Male	0.498	0.486	0	1
	(0.500)	(0.500)		
Female	0.502	0.514	0	1

	(0.500)	(0.500)		
White	0.864	0.852	0	1
	(0.343)	(0.355)		
Non-White	0.017	0.010	0	1
	(0.129)	(0.101)		
Ethnicity: Missing	0.119	0.137	0	1
	(0.324)	(0.344)		
No free school meals	0.917	0.868	0	1
	(0.276)	(0.338)		
Receives free school meals	0.071	0.126	0	1
	(0.256)	(0.332)		
School meals: Other or don't know'	0.002	0.002	0	1
	(0.040)	(0.045)		
School meals: Missing	0.011	0.004	0	1
	(0.103)	(0.064)		
Social Class: I	0.048	0.006	0	1
	(0.214)	(0.075)		
Social Class: II	0.174	0.063	0	1
	(0.379)	(0.244)		
Social Class: III non manual	0.089	0.057	0	1
	(0.285)	(0.231)		
Social Class: III manual	0.433	0.512	0	1
	(0.495)	(0.500)		
Social Class: IV	0.136	0.199	0	1
	(0.343)	(0.399)		
Social Class: V	0.044	0.071	0	1
	(0.204)	(0.257)		
Social Class: Missing	0.076	0.092	0	1
	(0.266)	(0.290)		
Household Size: 1 or 2	0.015	0.019	0	1
	(0.120)	(0.136)		
Household Size: 3	0.167	0.155	0	1
	(0.373)	(0.362)		
Household Size: 4	0.330	0.266	0	1
	(0.470)	(0.442)		
Household Size: 5	0.231	0.232	0	1
	(0.422)	(0.422)		
Household Size: 6+	0.255	0.325	0	1
	(0.436)	(0.468)		
Household Size: Missing	0.002	0.003	0	1
	(0.049)	(0.050)		
No siblings	0.073	0.057	0	1
	(0.259)	(0.232)		
1 to 3 siblings	0.735	0.656	0	1
	(0.441)	(0.475)		
4+ siblings	0.185	0.280	0	1
	(0.388)	(0.449)		
Siblings: Missing	0.008	0.007	0	1
	(0.087)	(0.081)		
Parents: Low Education	0.417	0.557	0	1
	(0.493)	(0.497)		
Parents: Medium Education	0.475	0.420	0	1
	(0.499)	(0.494)		

Parents: High Education	0.096	0.012	0	1
	(0.295)	(0.108)		
Parental Education: Missing	0.011	0.011	0	1
	(0.103)	(0.105)		
Parents not much interested	0.566	0.725	0	1
	(0.496)	(0.447)		
At least one parent interested	0.412	0.254	0	1
	(0.492)	(0.436)		
Parental interest: Missing	0.022	0.020	0	1
	(0.147)	(0.141)		
No own room	0.110	0.133	0	1
	(0.314)	(0.340)		
Has own room	0.880	0.854	0	1
	(0.325)	(0.353)		
Room info: Missing	0.009	0.012	0	1
	(0.096)	(0.110)		
Observations	4906	1958		

Notes: mean coefficients; sd in parentheses. Sweep 3, NCDS

Outcome values tend to be lower, on average, for the social housing sample than the full sample. At the same time, individuals in the social housing subsample live on average in more deprived areas. There are no relevant differences concerning gender and ethnicity across the two samples, and individuals in the social housing sample are more likely to live in urban areas than individuals in the full sample. The percentage of adolescents receiving free school meals is only marginally higher in the social housing sample than in the full sample, but, overall, both social class and parental education tend to be lower in the former than in the latter. A striking difference concerning the two samples concerns parental interest in education, as the percentage of households in which at least one parent is interested is twofold in the full sample, compared to the social housing one. I don't observe remarkable differences concerning household size, number of siblings, has one room for self or not.

3.2.2. Empirical strategy

To estimate the effect of neighbourhood deprivation on the five cognitive and non-cognitive outcomes, I perform a series of cross-sectional models. I adopt a seemingly unrelated regression approach (Zellner 1962). Such empirical approach assumes error terms to be correlated across equations and is thus more appropriate to estimate an effect on outcomes that are likely to be closely related. In this case the five outcomes are moderately to highly correlated. Table A6 in Appendix A showcases the outcomes' correlation. I model all five equations, one for each outcome, together. The final model can be summarised according to the following equation:

$$y_{ir} = \beta_i x_{ir} + \varepsilon_{ir} \qquad i = 1, \ldots, m$$

With *m* regression equations, *i* represents the equation number, *r* =1,…,R represents the individual observation and *x* is the vector of covariates including the interaction term between neighbourhood and gender.

I present, first, the analysis on the full sample and, later, the results from the social housing sample. In both cases, I adopt a step-wise approach, progressively adding different sets of covariates. More specifically, for each outcome, four different models are showcased. Model 1 only includes, as a predictor, neighbourhood deprivation. In Model 2, individual and spatial characteristics are included. Model 3 additionally adds all other parental and household-related characteristics. Finally, Model 4 includes and tests the interaction term between gender and neighbourhood deprivation, allowing me to assess heterogeneity by gender. This approach is well-suited to this analysis since it allows for a clearer identification of if and how the neighbourhood coefficient varies when different type of information are included in the model.

3.3. Results

Table 3.2 presents findings on neighbourhood and gender effects on five outcomes: cognitive skills, academic motivation, employability skills, lack of internalising behaviour and lack of externalising behaviour. I present the evolution of the main coefficients of interest (neighbourhood deprivation, gender and their interaction) across all outcomes. Table A7 available in the Appendix A summarises in a unique table the final model while showcasing all control variables. Deprivation scores are standardised, such that the coefficients should be interpreted in terms of one standard deviation difference.

Table 3.2. Neighbourhood and gender effects on cognitive and non-cognitive outcomes, full sample

	(1)	(2)	(3)	(4)
Cognitive Skills	Model 1	Model 2	Model 3	Model 4
Nhb deprivation(std)	**-0.306*** **	**-0.382*** **	**-0.155*** **	**-0.112*** **
	(0.017)	**(0.020)**	**(0.019)**	**(0.025)**
Gender/Ref: Male				
Female		-0.140***	-0.170***	-0.170***
		(0.033)	(0.030)	(0.030)
Female*Nhb				**-0.083** **
				(0.030)
Constant	0.122***	0.186**	0.213+	0.210+
	(0.017)	(0.071)	(0.123)	(0.123)

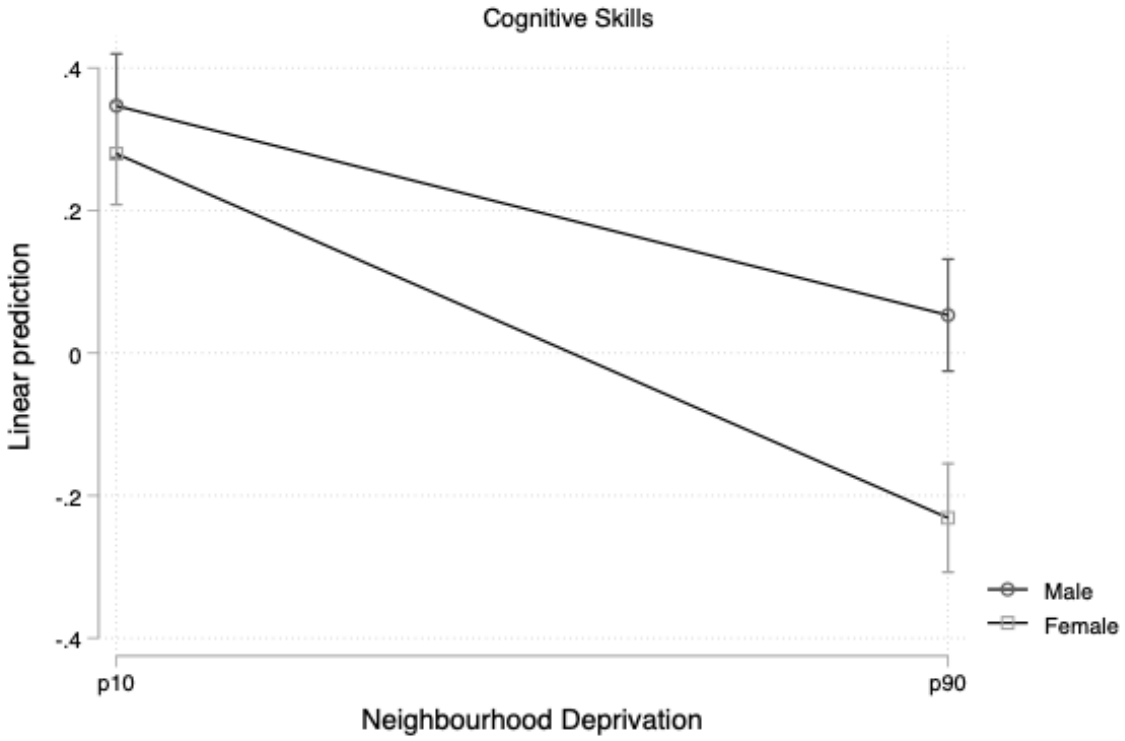
Observations	4,906	4,906	4,906	4,906
R-squared	0.063	0.098	0.283	0.284
	(1)	(2)	(3)	(4)
Academic Motivation	Model 1	Model 2	Model 3	Model 4
Nhb deprivation(std)	**-0.071*** **	**-0.088*** **	**-0.023* **	**0.009**
	(0.009)	**(0.011)**	**(0.011)**	**(0.014)**
Gender/Ref: Male				
Female		0.095***	0.081***	0.081***
		(0.017)	(0.017)	(0.017)
Female*Nhb				**-0.062*** **
				(0.016)
Constant	0.010	-0.018	-0.088	-0.090
	(0.009)	(0.037)	(0.068)	(0.068)
Observations	4,906	4,906	4,906	4,906
R-squared	0.013	0.024	0.129	0.131
	(1)	(2)	(3)	(4)
Employability Skills	Model 1	Model 2	Model 3	Model 4
Nhb deprivation(std)	**-0.079*** **	**-0.100*** **	**-0.034*** **	**-0.018+**
	(0.006)	**(0.008)**	**(0.007)**	**(0.009)**
Gender/Ref: Male				
Female		0.079***	0.070***	0.070***
		(0.013)	(0.011)	(0.011)
Female*Nhb				**-0.030** **
				(0.011)
Constant	0.004	0.007	-0.085+	-0.086+
	(0.006)	(0.027)	(0.047)	(0.047)
Observations	4,906	4,906	4,906	4,906
R-squared	0.030	0.050	0.225	0.226
	(1)	(2)	(3)	(4)
Lack of Internalising Behaviour	Model 1	Model 2	Model 3	Model 4
Nhb deprivation(std)	**-0.050*** **	**-0.067*** **	**-0.035*** **	**-0.027** **
	(0.005)	**(0.006)**	**(0.007)**	**(0.009)**
Gender/Ref: Male				
Female		0.013	0.008	0.008
		(0.011)	(0.011)	(0.011)
Female*Nhb				**-0.014**
				(0.010)
Constant	-0.023***	0.011	0.017	0.017
	(0.005)	(0.023)	(0.044)	(0.044)

Observations	4,906	4,906	4,906	4,906
R-squared	0.018	0.032	0.078	0.078
	(1)	(2)	(3)	(4)
Lack of Externalising Behaviour	Model 1	Model 2	Model 3	Model 4
Nhb deprivation(std)	**-0.101*** **	**-0.129*** **	**-0.062*** **	**-0.051*** **
	(0.009)	**(0.010)**	**(0.011)**	**(0.014)**
Gender/Ref: Male				
Female		0.124***	0.115***	0.115***
		(0.017)	(0.016)	(0.016)
Female*Nhb				**-0.021**
				(0.016)
Constant	-0.049***	-0.055	-0.162*	-0.162*
	(0.009)	(0.037)	(0.068)	(0.068)
Observations	4,906	4,906	4,906	4,906
R-squared	0.027	0.051	0.144	0.145

Notes: Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Regional Fixed Effects included. Model 1 includes only neighbourhood characteristics; Model 2 additionally includes individual & spatial characteristics; Model 3 adds parental & household characteristics; Model 4 includes the neighbourhood-gender interaction term.

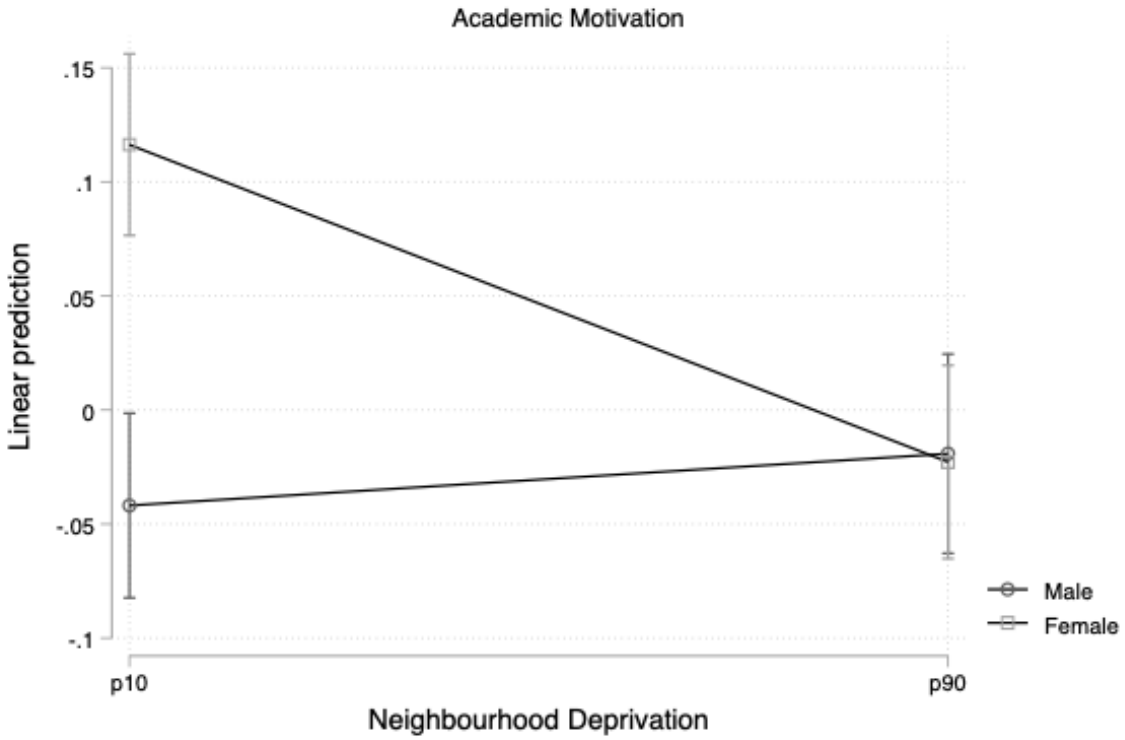
Looking first at cognitive skills, results indicate that neighbourhood deprivation is consistently and negatively associated with the outcome. In Model 3, which includes all relevant control variables, a standard deviation increase in neighbourhood deprivation on average decreases cognitive abilities by 0.155 units (on a range from -3.84 to 2.81). I also observe a strong and negative effect of being female on cognitive skills. While this might be counterintuitive at first, considering that there is robust evidence highlighting girls' cognitive advantage, this is most likely driven by the life stage, in line with studies that stress that girls' advantage in cognitive development during early childhood tends to shade over time (Kent & Pitsia, 2018). The interaction term in Model 4 shows that, in terms of cognitive skills, girls suffer more than boys when living in a more deprived residential context (a standard deviation increase in neighbourhood deprivation indeed decreases academic motivation by 0.19 units for girls as compared to 0.11 for boys). Figure 1 depicts the differential trend experienced by boys and girls at the 10^{th} and 90^{th} percent of the distribution of the neighbourhood measure.

Figure 3.1. Interaction between neighbourhood deprivation and gender, cognitive skills



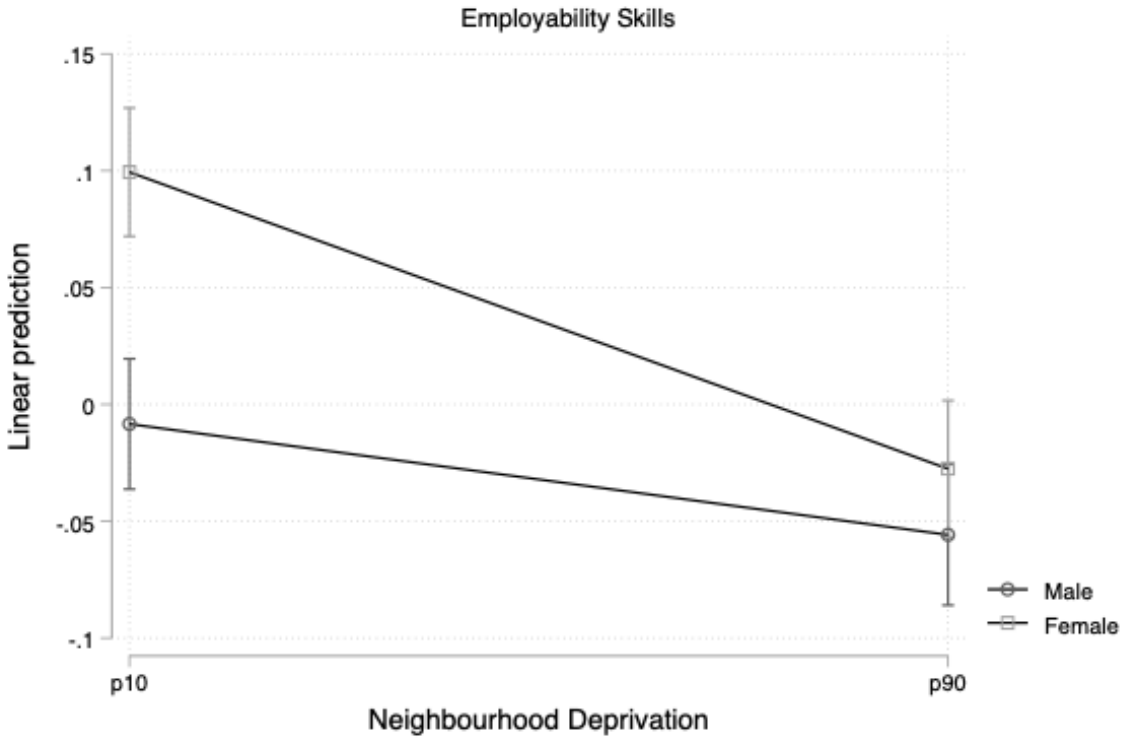
Neighbourhood deprivation is also significantly associated with academic motivation except for Model 4 (spanning from – 2.09 to 1.51). Being female is also significantly and positively related to the outcomes, across all models. The interaction term between neighbourhood and gender is negative and significant, which seems to indicate that neighbourhood socio-economic conditions do matter for academic motivation, and especially for females. A standard deviation increase in neighbourhood deprivation indeed decreases academic motivation by about 0.05 units for girls, but it does not have any effect on boys. Figure 2 graphically shows again the interaction term at the two extremes of the neighbourhood distribution, confirming the steep decline in motivation experienced by females.

Figure 3.2. Interaction between neighbourhood deprivation and gender, academic motivation



Models on employability skills show that the neighbourhood indicator is negatively and significantly related with the outcomes across all Models. Nonetheless, when the neighbourhood-gender interaction term is added to the equation, the neighbourhood predictor loses its significance, while the interaction term becomes negatively and significantly related to the outcome. These results, thus, mirror those pictured for academic motivation, whereas there seems to be a relevant effect of the neighbourhood with this being particularly relevant to females rather than males, as also shown in Figure 3. For girls indeed, a standard deviation increase in neighbourhood deprivation leads to a decrease in employability skills lower of 0.048 units (with employability skills ranging from -1.6 to 1.2).

Figure 3.3. Interaction between neighbourhood deprivation and gender, employability skills



Finally, neighbourhood deprivation is strongly and negatively related to both lack of internalising and externalising problems (which span respectively from -1.72 to 0.39 and from -2.86 to 0.56). In Model 3, a standard deviation increase in neighbourhood deprivation decreases the lack of internalising and externalising problems (thus, increasing the presence of such problems) by 0.035 and 0.06 units respectively. Moreover, females are significantly less prone to showcase externalising problems than males, while there is no specific gender difference when it comes to the internalising dimension. The interaction term that models together the effect of the neighbourhood and gender is in both cases not significant, meaning that while living in a more deprived context negatively affects internalising and externalising outcomes, this effect is independent on the individual's gender. Indeed, this is clearly visible in Figures 4 and 5, which depict the interaction term.

Figure 3.4. Interaction between neighbourhood deprivation and gender, lack of internalising behaviour

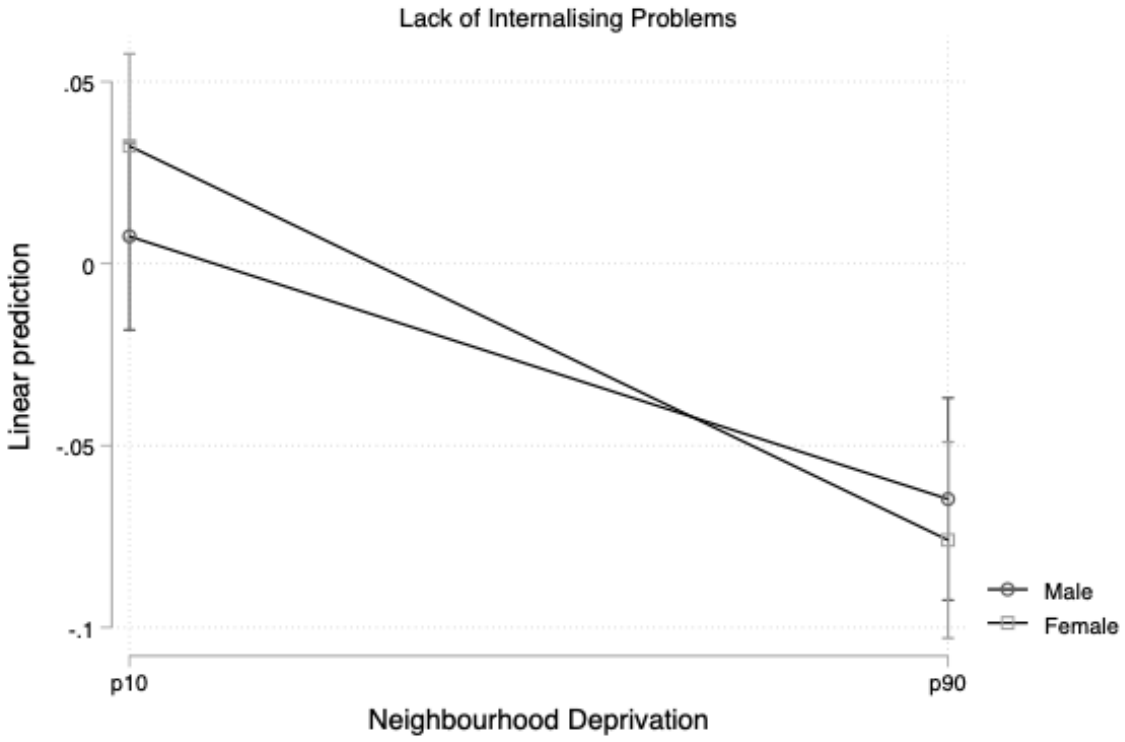
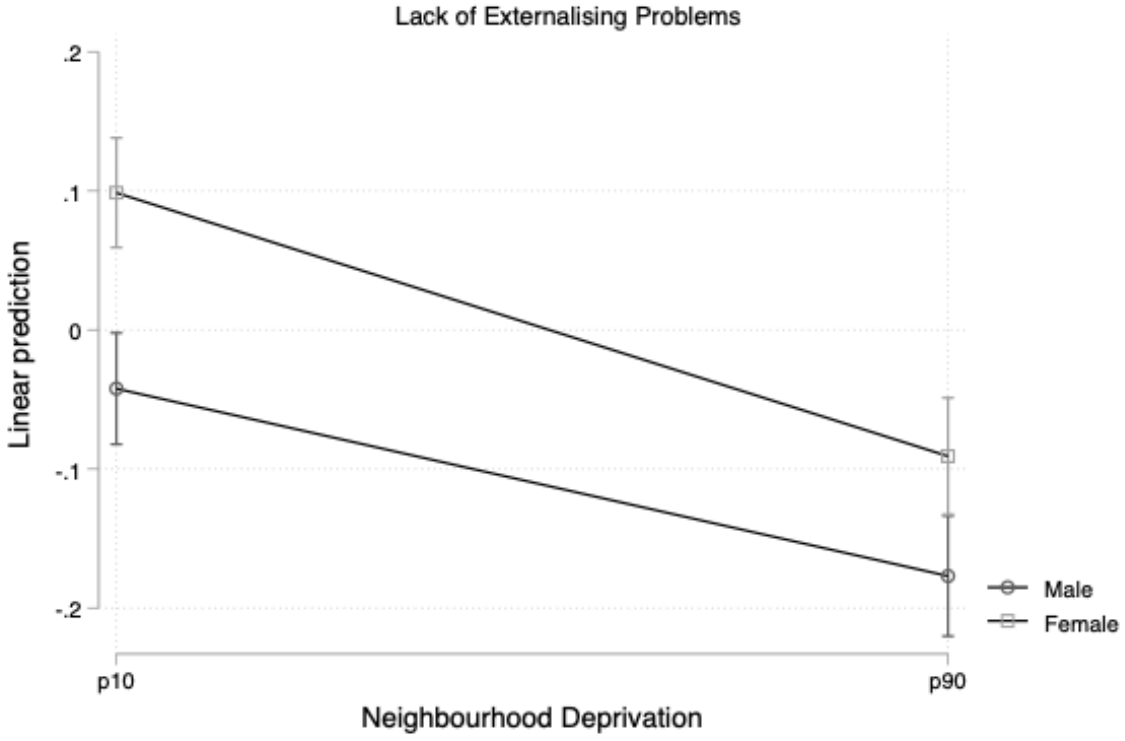


Figure 3.5. Interaction between neighbourhood deprivation and gender, lack of externalising behaviour



In sum, living in a more deprived area overall negatively affects cognitive and non-cognitive skills. However, neighbourhood deprivation has a significantly more negative effect on adolescent girls', rather than boys', cognitive skills, academic motivation and employability skills, while no significant gender difference is detected for problem behaviour.

3.3.1. Robustness Checks

Table 3.3 below presents the same results depicted in Table 3.2 for the full sample, but for the social housing sample. Table A8 available in the Appendix A summarise in a unique table the final model including all control variables.

Table 3.3. Neighbourhood and gender effects on cognitive and non-cognitive outcomes, social housing sample

	(1)	(2)	(3)	(4)
Cognitive Skills	Model 1	Model 2	Model 3	Model 4
Nhb deprivation(std)	**-0.057***	**-0.171*****	**-0.131*****	**-0.083***
	(0.026)	**(0.033)**	**(0.031)**	**(0.039)**
Gender/Ref: Male				
Female		-0.285***	-0.307***	-0.307***
		(0.051)	(0.047)	(0.047)
Female*Nhb				**-0.094***
				(0.047)
Constant	-0.299***	-0.228*	0.787*	0.785*
	(0.026)	(0.110)	(0.353)	(0.353)
Observations	1,958	1,958	1,958	1,958
R-squared	0.002	0.055	0.212	0.213
	(1)	(2)	(3)	(4)
Academic Motivation	Model 1	Model 2	Model 3	Model 4
Nhb deprivation(std)	**-0.012**	**-0.020**	**-0.021**	**0.017**
	(0.014)	**(0.018)**	**(0.017)**	**(0.022)**
Gender/Ref: Male				
Female		0.028	0.018	0.018
		(0.028)	(0.026)	(0.026)
Female*Nhb				**-0.073****
				(0.026)
Constant	-0.101***	-0.060	0.159	0.158
	(0.014)	(0.060)	(0.199)	(0.198)
Observations	1,958	1,958	1,958	1,958
R-squared	0.000	0.007	0.124	0.127
	(1)	(2)	(3)	(4)

Employability Skills	Model 1	Model 2	Model 3	Model 4
Nhb deprivation(std)	**-0.020^{+}**	**-0.040****	**-0.038****	**-0.016**
	(0.010)	**(0.013)**	**(0.012)**	**(0.015)**
Gender/Ref: Male				
Female		0.037	0.032	0.032
		(0.020)	(0.018)	(0.018)
Female*Nhb				**-0.041***
				(0.018)
Constant	-0.114***	-0.084	0.215	0.214
	(0.010)	(0.043)	(0.138)	(0.138)
Observations	1,958	1,958	1,958	1,958
R-squared	0.002	0.016	0.197	0.199
	(1)	(2)	(3)	(4)
Lack of Internalising Behaviour	Model 1	Model 2	Model 3	Model 4
Nhb deprivation(std)	**-0.022***	**-0.052*****	**-0.048*****	**-0.044***
	(0.009)	**(0.012)**	**(0.011)**	**(0.015)**
Gender/Ref: Male				
Female		-0.017	-0.022	-0.022
		(0.018)	(0.017)	(0.017)
Female*Nhb				**-0.007**
				(0.017)
Constant	-0.094***	-0.070	0.053	0.053
	(0.009)	(0.038)	(0.131)	(0.131)
Observations	1,958	1,958	1,958	1,958
R-squared	0.003	0.021	0.073	0.073
	(1)	(2)	(3)	(4)
Lack of Externalising Behaviour	Model 1	Model 2	Model 3	Model 4
Nhb deprivation(std)	**-0.042****	**-0.088*****	**-0.081*****	**-0.061***
	(0.015)	**(0.019)**	**(0.018)**	**(0.023)**
Gender/Ref: Male				
Female		0.101***	0.094**	0.094**
		(0.029)	(0.028)	(0.028)
Female*Nhb				**-0.038**
				(0.027)
Constant	-0.182***	-0.215**	0.125	0.12
	(0.015)	(0.063	(0.208)	(0.208)
Observations	1,958	1,958	1,958	1,958
R-squared	0.004	0.026	0.136	0.137

Notes: Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Regional Fixed Effects included. Model 1 includes only neighbourhood characteristics; Model 2 additionally includes individual &

spatial characteristics; Model 3 adds parental & household characteristics; Model 4 includes the neighbourhood-gender interaction term.

Overall, results obtained for the social housing sample are not substantially different than those obtained for the full sample, except for the relationship between, respectively, neighbourhood deprivation and gender on academic motivation and employability skills. Nonetheless, the main results concerning the interaction term between neighbourhood disadvantage and gender are unvaried. This contributes to significantly strengthen the validity of my findings, since it allows me to be more confident that they are robust to endogeneity and that are not affected by neighbourhood selection.

I conduct two additional analyses to further validate my findings. I try to i) partial out additional sources of endogeneity and ii) ease the restriction related to the length of exposure to the neighbourhood. Both analyses are also carried out also on the narrower social housing sample, with results substantially similar to those reported for the full sample.

The NCDS does not include information on non-cognitive skills prior to age 16 but I can leverage a measure of cognitive abilities at age 7. Table 3.4 reports results after including in the model information on childhood cognitive abilities. We observe that including prior cognitive skills reduces the size of both the main neighbourhood effect and the gender interaction effect on cognitive skills at 16. Adding childhood cognitive measures reduces the statistical significance of the association between deprivation and academic motivation and employability skills. However, it marginally improves the explanatory power of the model (higher variability explained) and leaves the interaction coefficient unchanged. Results on the last two outcomes also remain unvaried.

Table 3.4. Robustness Check: Adding prior cognitive skills (at age 7)

VARIABLES	(1) Cognitive Skills	(2) Academic Motivation	(3) Employability Skills	(4) Lack of Internalising Behaviour	(5) Lack of Externalising Behaviour
Nhb deprivation(std)	**-0.064****	**0.016**	**-0.009**	**-0.021***	**-0.045****
	(0.022)	**(0.015)**	**(0.010)**	**(0.009)**	**(0.015)**
Gender/Ref: Male					
Female	-0.211***	0.084***	0.070***	0.005	0.109***
	(0.025)	(0.017)	(0.012)	(0.011)	(0.017)
Female*Nhb	**-0.052***	**-0.058*****	**-0.028***	-0.008	-0.011
	(0.025)	**(0.017)**	**(0.012)**	(0.011)	(0.017)
Cognitive skills at 7	0.551***	0.033***	0.047***	0.053***	0.077***
	(0.012)	(0.008)	(0.005)	(0.005)	(0.008)
Constant	0.182+	-0.071	-0.088+	0.008	-0.185**

	(0.106)	(0.073)	(0.050)	(0.046)	(0.071)
Observations	4,462	4,462	4,462	4,462	4,462
R-squared	0.521	0.133	0.243	0.102	0.167

Notes: Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Regional fixed effects included.

In Table 3.5, I drop restrictions related to the time of exposure to the neighbourhood and, thus, present results for the whole sample of individuals living in social housing at age 16, regardless of the time in which they first moved into the area. Results are aligned with those presented in Table 3.2 (Model 4) of the manuscript, although in most cases coefficients tend to be smaller. The interaction coefficient on cognitive skills, passes from being significant at p<0.05 to p<0.10. Including in the sample also adolescents who have lived in the neighbourhood for a shorter amount of time seems overall to mitigate the negative effect of neighbourhood deprivation, possibly hinting at a cumulative impact of neighbourhood disadvantage on the outcomes.

Table 3.5. Robustness Check: Removing restrictions based on exposure to the neighbourhood

VARIABLES	(1) Cognitive Skills	(2) Academic Motivation	(3) Employability Skills	(4) Lack of Internalising Behaviour	(5) Lack of Externalising Behaviour
Nhb deprivation(std)	**-0.135*** **	0.002	**-0.021** **	**-0.028*** **	**-0.060*** **
	(0.020)	(0.011)	**(0.008)**	**(0.007)**	**(0.011)**
Gender/Ref: Male					
Female	-0.165***	0.094***	0.080***	0.012	0.126***
	(0.024)	(0.013)	(0.009)	(0.008)	(0.013)
Female*Nhb	**-0.036+**	**-0.045*** **	**-0.020***	-0.011	-0.009
	(0.024)	**(0.013)**	**(0.009)**	(0.008)	(0.013)
Constant	0.132	-0.143*	-0.133***	-0.026	-0.272***
	(0.103)	(0.057)	(0.040)	(0.037)	(0.057)
Observations	7,973	7,973	7,973	7,973	7,973
R-squared	0.289	0.134	0.230	0.074	0.151

Notes: Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Regional fixed effects included.

3.4. A discussion about the underlying mechanisms

Due to the nature of the data, the NCDS does not have sufficient information to allow us to test the direct underlying mechanism for which the relationship between neighbourhood characteristics and gender appears stronger for females. Nonetheless, by leveraging the

literature and some descriptive information, it is perhaps possible to hint at some potential mechanisms that should, however, be explored more in depth in future research. As the gender gap indeed starts early on (Moffitt, 1993; Legewie and DiPrete, 2012), understanding what mechanisms at the neighbourhood level might significantly influence women's position of disadvantage in adolescence becomes also relevant for exploring and better shaping females' patterns throughout the life course.

The findings of this work do not support the idea proposed by some authors (Entwisle et al.,1994; Nieuwenhuis et al, 2015) that the mere fact of "hanging around" makes the neighbourhood effect stronger for boys. In fact, while the NCDS does not provide a direct measure of time spent in the neighbourhood, we could perhaps advance some hypothesis on the fact that males tend to be more outside as compared to girls based on information on daily activities and satisfaction with the neighbourhood. Across the NCDS, there are more boys than girls who live in the most deprived quintile and declare to go out in the evening for at least five times a week (19% vs. 12%), with such difference becoming higher when looking specifically at youth in social housing (27% vs. 18%). Furthermore, 44% of males state that they *often* play outdoor games and sports, compared to just 14% of females (respectively 46% and 14% for youth in social housing).

Furthermore, noticeably for girls, the neighbourhood seems to have a unique influence on those non-cognitive outcomes that, importantly, *do relate to educational and cognitive performance*. Such a finding could be helpful in discerning among the potential theoretical mechanisms listed above and through which females may be affected by their local area characteristics. In fact, they possibly point towards an important role of academic-related pathways, such gender stereotypes and support by teachers and neighbours.

The NCDS includes data on the cohort members' as well as their parents' aspirations about school and work. In table 3.6 below I observe how parental wishes about their child education vary by population quintiles of neighbourhood deprivation. Overall, parental wishes about children education seem to disadvantage females as compared to males. The more deprived the residential area, the greater the percentage of parents that seem to be more keen to have girls leave school at minimum age and boys to stay on in education (although Q1 is an exception). When it comes to pursuing education full time, in a similar fashion, I see that in deprived areas there is a greater proportion of parents who hope their *male* child will continue studying, and less that their *female* child will stay in education, a pattern that is opposite of the one characterising less deprived areas.

Table 3.6. Parental wishes about child education, by sex and neighbourhood deprivation quintile

	Parental wishes about child education						
		Q1	Q2	Q3	Q4	Q5	N
NA	Male	41%	56%	54%	49%	49%	1,116
	Female	59 %	44%	46%	51%	51%	1,073
Leave min. age	Male	50%	56%	58%	55%	50%	1,765
	Female	50%	44%	42%	45%	50%	1,547
Full time up to 18	Male	31%	44%	43%	43%	49%	1,048
	Female	69%	56%	57%	57%	51%	1,307
Full time over 18	Male	49%	48%	49%	50%	52%	1,442
	Female	51%	52%	51%	50%	48%	1,233
Uncertain	Male	100%	54%	52%	55%	46%	293
	Female	-	46%	48%	45%	54%	279
N		222	1,334	2,585	3,130	4,032	11,303

Notes: elaboration upon the author, based on NCDS Sweep 3, excludes missing data on neighbourhood. Q1 is the least deprived neighbourhood quintile; Q5 is the most deprived neighbourhood quintile.

When it comes to school, teachers also seem to be more confident in males', rather than females' ability. In table 3.7 below, teachers respond to the question of whether staying at school would benefit or not the child. In the least deprived neighbourhood quintile there is a greater proportion of teachers who states that schools would benefit female child (59%) as compared to the most deprived quintile (53%). Moreover, 45% of teachers says that staying at school would not benefit the (female) child in the least deprived quintile, versus 48% in the most deprived neighbourhood quintile.

Table 3.7. Teachers' view about child education, by sex and neighbourhood deprivation quintile

	Stay at school: would benefit child?						
		Q1	Q2	Q3	Q4	Q5	N
NA	Male	40%	50%	53%	51%	47%	733
	Female	60 %	50%	47%	49%	53%	749
Yes	Male	41%	47%	46%	46%	47%	1,934
	Female	59%	53%	54%	54%	53%	2,259
No	Male	55%	55%	59%	54%	52%	2,367
	Female	45%	45%	41%	46%	48%	1,973

Uncertain	Male	67%	55%	45%	49%	49%	630
	Female	33%	45%	55%	51%	51%	658
N		222	1,334	2,585	3,130	4,032	11,303

Notes: elaboration upon the author, based on NCDS Sweep 3, excludes missing data. Q1 is the least deprived neighbourhood quintile; Q5 is the most deprived neighbourhood quintile.

The NCDS also gathers information about the cohort member's own expectations about the age they are likely to leave school. In the Table 3.8 below, I present how the proportion between males and females varies by deprivation quintile. For both boys and girls, the proportion of children who argue they will be likely to leave school at 16 years increases from Q1 to Q5, while the proportion of those mentioning they will be leaving school at 18 or over decreases between Q1 and Q5.

Table 3.8. Age likely to leave school, by sex and neighbourhood deprivation quintile

	Age likely to leave school					
		Q1	Q2	Q3	Q4	Q5
NA	Male	11%	10%	15%	15%	16%
	Female	12 %	10%	13%	15%	17%
16 years	Male	31%	41%	52%	56%	62%
	Female	35%	42%	49%	55%	60%
17 years	Male	5%	7%	5%	5%	6%
	Female	5%	7%	6%	6%	6%
18 years or over	Male	37%	33%	21%	16%	9%
	Female	39%	34%	25%	19%	11%
Uncertain	Male	15%	9%	8%	7%	7%
	Female	10%	7%	7%	5%	5%
Total		222	1,234	2,585	3,130	4,032

Notes: elaboration upon the author, based on NCDS Sweep 3, excludes missing data. Q1 is the least deprived neighbourhood quintile; Q5 is the most deprived neighbourhood quintile.

Although gender-related patterns here seem to be similar, an interesting element comes from the answers provided the question investigating the reasons for which youth felt most likely to prefer leaving school early on. The vast majority of members argue that earning a living and becoming independent is their main reasons for leaving school at 16. Among other reasons, there are the need to work to help family finances, the decision to follow parent and teachers' advice, as well as the type of occupation desired. Finally, two of the reasons well-connect to the idea of gender stereotypes, the desire to get married soon and the fact that children feel they

are not good enough to stay on. About this last answer, out of overall 41 children who respond they would be leaving school at 16 since they feel not good enough the great majority (27) are female, a great part of which (16) inhabit in the most deprived neighbourhood quintile.

3.5. Discussion and conclusion

This chapter investigated neighbourhood effects on youth cognitive and non-cognitive skills and assessed the heterogeneity of the effects. The main findings provide support for a negative role of neighbourhood deprivation on the outcomes, in particular cognitive skills and socio-emotional behaviour, confirming results from previous work that highlighted how growing up in poorer neighbourhoods may have relevant and long-lasting consequences (Sampson, 2012). A second insight from this paper relates to the fact that neighbourhood effects appear, in some cases, to be "gendered". In fact, while the surrounding environment similarly affects boys' and girls' problem behaviour, the influence of neighbourhood socio-economic deprivation is much more marked on girls with respect to boys when it comes to cognitive skills, academic motivation and employability skills.

By leveraging descriptive information, I tried to discern among the theorised different potential mechanisms that could result in a negative cumulative effect driven by, on the one hand, living in a disadvantaged neighbourhood environment and, one the other hand, being an adolescent girl. Both parents and teachers seem to me less supportive, in deprived areas, for girls' education as compared to boys' education. Moreover, more girls as compared to boys, in deprived areas, report answers about school that seem to be more in line an overall lower self-efficacy, perception of one's abilities, and more broadly with the presence of gender stereotypes concerning women's role within society. While none of this mechanism has been here formally tested, they do provide relevant food for thought concerning gender-specific pathways through which neighbourhoods might exert their effects and thus contribute to refine existing neighbourhood theories.

From a methodological point of view, I find similar effects for both the main sample and a subsample of individuals living in social housing. By leveraging the quasi-exogeneity of the British social housing allocation process, this paper has managed to reduce selection bias in the assessment of neighbourhood effects. Although the use of this strategy cannot be compared to fully randomized experiments such as the notorious Moving To Opportunity, it does contribute to better isolating neighbourhood effects and providing increased confidence in the fact that results are not merely driven by processes of neighbourhood selection. Moreover, it is

important to highlight that, while residential sorting may be troublesome for neighbourhood research, I would not expect it to pose any threats when it comes to gender differences. People's neighbourhood choices indeed do not normally depend on their children's gender, thus it is unlikely that residential selection could anyway be a driver of the gender effects found in this work.

Chapter 4

Neighbourhood effects across generations and the reproduction of inequality

Introduction

The majority of neighbourhood studies typically focus on estimating how the residential context, measured in a single point of time, affects children's outcomes, implicitly assuming that only the child's current neighbourhood matters. However, research points to a complex and rather long-lasting and sticky process by which social institutions, such as families or neighbourhoods, shape children's opportunities structures over time and their relative outcomes (Ganzeboom et al., 1991; Solon, 1999; Bowles et al., 2005; Morgan et al., 2006; Black and Devereux, 2010; Blau and Duncan, 1967). Considering all this, a single-generation approach may underestimate the full dimensionality of how and when neighbourhood context matters for inequality (Sharkey and Elwert, 2010, 2011; Alvarado and Cooperstock, 2021). Hence, this chapter focuses on neighbourhood deprivation over time and assesses the existence of neighbourhood effects across two generations on two youth developmental outcomes, cognitive skills and socio-emotional behaviour.

Scholars have hypothesised multiple mechanisms through which children's local neighbourhood context might affect the development of cognitive and socio-emotional outcomes. These include, for example, the presence, or lack, of positive role models, forms of socialization with peers, the role of institutional quality, as well as the level of collective efficacy (Wilson, 1987; Galster, 2012; Sampson, 2012). Overall, these mechanisms point to a negative association between living in a disadvantaged neighbourhood while growing up and youth outcomes. At the same time, some recent evidence suggests that past family neighbourhood environments might also have a lingering effect on children's attainment in the following generation (Sharkey, 2008; Sampson, 2008; Small and Feldman, 2012). Lead exposure in the residential area during the early life course, for example, has long-lasting consequences on well-being and perpetuates its effect beyond a single generation (Sampson, 2022). Moreover, Sharkey and Elwert (2010, 2011) find evidence, in the US, of a deleterious effect of living in poor residential areas across two generations on children's cognitive skills, parents' educational expectations, and aspirations. In this chapter, I expand this line of inquiry by responding to the following questions: is there a multigenerational neighbourhood effect on cognitive skills and socio-emotional behaviour in the UK? Do family histories of neighbourhood disadvantage matter for these outcomes?

In order to investigate the longstanding effect of two generations of neighbourhood environment, I exploit data from the 1958 National Child Development Study. I use neighbourhood and individual data for the original cohort when participants were 16 years old,

i.e. in 1974, in combination with neighbourhood and individual information concerning their children, gathered in 1991. For the empirical analysis, I employ standard OLS techniques and also implement a Regression with Residuals (RWR) design (Wodtke, 2018; Wodtke and Almirall, 2017; Wodtke et al., 2020; Zhou and Wodtke, 2019). This specification allows me to take into account post-treatment confounders and is therefore particularly suited to estimating effects over time.

This chapter adds to the literature on neighbourhood effects. First, I expand upon previous research on multigenerational neighbourhood effects (Sharkey and Elwert, 2010; Sharkey and Elwert, 2011) by focusing on a new outcome, socio-emotional behaviour. Socio-emotional behaviour is an important predictor of life success (Cunha and Heckman, 2007) and there is a vast amount of research that finds evidence for the childhood neighbourhood environment shaping this outcome (Sampson et al., 2002). Yet, we don't know whether longer-term, multigenerational patterns of residential deprivation might also play a role. Second, I pay particular attention to trajectories of neighbourhood deprivation over generations and how these might affect individual outcomes. Plenty of research has estimated the effect of moving up and down the social ladder between different generations within a family (Pfeffer, 2014). I focus here on the relatively understudied dimension of spatial mobility, estimating the differential impact of stable, upward and downward trajectories of neighbourhood disadvantage across two generations. Finally, the limited research on multigenerational neighbourhood effects has been carried out in the US (Sharkey, 2010, 2011). In contrast, this work is based in the United Kingdom and therefore expands to a new empirical context.

4.1. Background

In this chapter, I focus on how socioeconomic disparities and disadvantages concentrated within specific spatial areas exert their effects across different generations. In particular, I consider two distinct neighbourhood environments (and related deprivation levels) which, to simplify the theoretical framework and its empirical application, are here defined as:

- $NEIGH_{CURR}$ is the neighbourhood measured in 1991, where the parents are currently living and where the offspring generation (whose outcomes are measured at the same time) is growing up;
- $NEIGH_{PAST}$ is the neighbourhood measured in 1974, where the grandparents were living at the time when parents were 16 years old.

I measure the independent effect of each of these two neighbourhood environments, their cumulative effect, and how their combination into different trajectories of neighbourhood disadvantage affects two outcomes: cognitive skills and socio-emotional behaviour.

4.1.1. Defining multigenerational neighbourhood effects

In this chapter, I am interested specifically in *multigenerational* effects. Defining these effects requires some explanations, also with reference to related concepts such as intergenerational effects. Sharkey and Elwert (2011) significantly contribute to clarify the theoretical and empirical distinction between these two approaches applied to the neighbourhood field.

The intergenerational perspective is concerned with transmission of advantage (or disadvantage) from parents to their children (Mare, 2011). Therefore, in the neighbourhood context intergenerational effects aim to capture the overall influence of parental neighbourhood conditions on child's cognitive ability, regardless of the pathway of influence (Sharkey and Elwert, 2011). Empirically speaking, the intergenerational effect is thus represented by the estimation of the effect of the neighbourhood that parents experienced during childhood ($NEIGH_{PAST}$) on their offspring's outcomes. In contrast, focusing on multigenerational neighbourhood effects means capturing the effect of placing *both* parents and youth in particular neighbourhood environments over time (Sharkey and Elwert, 2011). Theoretically speaking, adopting a multigenerational approach requires taking a longer-term perspective of social reproduction and appreciating the possibility that grandchildren may well receive benefits, either tangible or intangible, from their grandparents via different and multiple paths including the parental and the youth neighbourhood environment (Zhang and Li, 2019). Empirically speaking, capturing multigenerational effects requires a taking into account in the same model both $NEIGH_{PAST}$ and $NEIGH_{CURR}$. While different approaches could be taken to perform such analysis (see Sharkey and Elwert, 2011 for relevant examples) it is important to note that many of them pose relevant methodological challenges due to the endogeneity of $NEIGH_{CURR}$ with respect to $NEIGH_{PAST}$. Hence, estimating multigenerational effects thus overall require a robust methodological strategy, as will be detailed in the methodological section.

4.1.2. The effect of $\boldsymbol{NEIGH_{CURR}}$ on youth outcomes

In this chapter, I align with previous literature and analyse, in the first place, the effect of the current neighbourhood ($\boldsymbol{NEIGH_{CURR}}$) on youth cognitive skills and socio-emotional behaviour. Chapter 2 presented an overview of the area-related mechanisms that might provide some

explanation of neighbourhood effects, centred around processes of socialisation, collective efficacy, institutional quality and relative deprivation (Galster, 2012; Jencks and Mayer, 1990). All such mechanisms are unrelated to the parents. Overall, these theories suggest that growing up in more deprived areas has a detrimental effect on youth development. I build on these perspectives, as well as on relevant empirical evidence, which have both been previously discussed within this thesis, to develop the first hypothesis:

Hypothesis 1: Current neighbourhood deprivation ($NEIGH_{CURR}$) negatively affects offsprings' cognitive skills and socio-emotional behaviour.

4.1.3. Intergenerational effects: the effect of $NEIGH_{PAST}$ on youth outcomes

While some authors argue that point-in-time neighbourhood measures are reasonable proxies for the effects of long-run environments (Kunz et al., 2003; Jackson and Mare, 2007), others have instead started to question the focus on the current neighbourhood, suggesting that the transmission of opportunity and related inequality dynamics should be looked at in a longer-term perspective. Under this view, one neighbourhood measure ($NEIGH_{CURR}$) is not enough to understand the full scope through which neighbourhoods exert their effects. Even for individuals living in a same quality $NEIGH_{CURR}$, past neighbourhood experiences play a role by intergenerationally transmitting their influence, via several mechanisms.

First, the literature about the intergenerational transmission of context (Sharkey, 2008) suggests that there is a correlation between the type of neighbourhood experiences by individuals over time, and between the area in which parents grow up in and in which their children grow up in (Hedman et al., 2015). Limited housing options and residential mobility, combined with the lack of the necessary economic or social capital can indeed restrict individuals from moving to areas with better resources and opportunities, resulting in the concentration of disadvantaged populations in certain neighbourhoods over time. Similarly, the strength of the existing cultural and kinship networks also matters, as neighbourhoods contribute to shaping individuals' identity and cultural values. For example, social ties developed in neighbourhoods during the early life may affect residential choices and preferences later on (Alvarado and Cooperstock, 2021). Empirical evidence supports this idea. In the US, living in a low-quality neighbourhood during childhood negatively affects the quality of the neighbourhood during adulthood (Vartanian et al., 2007; Sharkey, 2008, 2013; Alvarado and Cooperstock, 2021), with intergenerational repercussions over offspring's outcomes. In Europe, scholars (Van Ham et al., 2014; Hedman et al., 2017; Gustafsson et al., 2017; McAvay

2018, 2020) uncover a similar pattern, for which the childhood context ($NEIGH_{PAST}$) exerts a significant effect on exposure to poor and segregated neighbourhoods later in life ($NEIGH_{CURR}$), which again might then affect next generation children's performance.

Second, unequal access to quality schools and educational resources can contribute to the perpetuation of inequality at the neighbourhood level. Disadvantaged neighbourhoods tend to have indeed underfunded schools, inadequate facilities, and a lack of experienced teachers (Sampson et al., 2022). Such circumstances and opportunities that individuals experience during their formative years can have a significant impact on their future prospects and outcomes. Authors have found indeed that exposure to neighbourhood disadvantage during childhood and adolescence significantly reduces adult educational attainment (Sampson et al., 2008; Wodtke et al., 2011). At the same time, research focusing on the intergenerational transmission of education (Van Doorn et al., 2011; Fiel, 2019) stresses how parents' educational achievement tends to be markedly associated with that of their children, which again emphasises the continuity in inequality over time. In sum, this means that early-life educational experiences, which are themselves shaped by residing in different types of neighbourhood environment ($NEIGH_{PAST}$), have the potential for intergenerational pathways to outcomes measured a generation later.

In combination with these first two aspects, disadvantaged neighbourhoods often suffer from a lack of job opportunities and economic investment. High unemployment rates, limited access to businesses, and a lack of investment in infrastructure can contribute to persistent poverty and income inequality within these communities. Again, authors have found a consistent association between childhood neighbourhood exposure and later employment status, income (Hedman et al., 2015; Alvarado, 2018, Vartanian and Buck, 2005) and wealth (Levy, 2022). In a recent analysis based in Sweden, for example, Branden et al. (2022) look at data from individuals born from 1983 to 1987 and find that growing up in a resource-rich neighbourhood is associated with better life outcomes, in terms of lower likelihood to rely on social welfare and higher likelihood to end up in the highest income population decile. Similar to educational advantage, social class and socio-economic status are also partly inherited by previous generations (Chan and Boliver, 2013; Zhang and Li, 2019). Therefore, if, again, characteristics of the residential area experienced during the early life course ($NEIGH_{PAST}$) influence future socio-economic attainment, and this is transmitted across generations, this represents another pathway through which neighbourhood environments in past generations can affect outcomes in the following one.

Finally, neighbourhoods with concentrated disadvantage may also face higher levels of crime, violence, and environmental hazards. These social and environmental factors can further exacerbate inequalities, affecting the physical and mental well-being of residents and limiting their opportunities for upward mobility. Numerous studies have found that living in a disadvantaged neighbourhood during childhood ($NEIGH_{PAST}$) reduces individuals' health status and wellbeing later on (Alvarado, 2019; Kravitz-Wirtz, 2016), both of which are tightly associated with their children's cognitive and, especially, socio-emotional outcomes (Madigan et al., 2018 and Feldman, 2007). Moreover, concerning specifically environmental hazards, a recent work by Sampson (2022) focuses on the long-standing consequences of lead exposure. Lead exposure is not unequally shared among the population, with poorer individuals, often living in racially and socio-economically segregated areas, bearing most of the consequences. Thus, according to Sampson (2022) "*lead exposure…has the capacity to generate further stratification by reproducing inequality between both individuals and neighbourhoods, and across generations*" (Sampson, 2022, p. 2).

Overall, all these mechanisms represent potential pathways accounting for persistence of disadvantage at the low end of the neighbourhood socioeconomic distribution. Based upon all these mechanisms, I would expect $NEIGH_{PAST}$ to exert an intergenerational effect on youth outcomes. Hence, my second hypothesis is:

Hypothesis 2: The previous generation's experiences of neighbourhood deprivation, $NEIGH_{PAST}$***, negatively affects offsprings' cognitive skills and socio-emotional behaviour.***

4.1.4. Multigenerational effects: the combined role of $NEIGH_{CURR}$ and $NEIGH_{PAST}$ on youth outcomes

In the previous paragraphs, I theorised that there exists an effect of $NEIGH_{CURR}$, but also an intergenerational effect driven by $NEIGH_{PAST}$ which might respectively shape youth outcomes. If that is the case, a third hypothesis shall be developed about multigenerational effects, which requires looking at the combination of these dimensions.

According to the theory of cumulative disadvantage (Levy, 2019, 2021), longer-term exposure to disadvantaged neighbourhood conditions is associated with worst outcomes than shorter-term exposure (Sampson et al., 2008; Musterd et al., 2012; Nieuwenheis et al., 2021). The mechanisms described in the previous paragraph, and through which neighbourhoods might intergenerationally pass on their effects, are thus likely to exacerbate over time and across generations. Empirical evidence supports the intuition that sustained exposure to

neighbourhood deprivation over time negatively influences life course attainment. Authors have found, for example, that the longer the exposure to neighbourhood disadvantage, the more negative the effect on educational achievement (Wodtke et al., 2011; Crowder and South, 2011) and on verbal skills (Sampson et al., 2008), although not on computational ability (Hicks et al., 2018). More direct evidence of the legacy of living in deprived areas is contained in work by Sharkey and Elwert (2010, 2011) where they specifically studied how neighbourhood poverty, experienced over two successive generations, influence children's cognitive skills, parents' educational expectations and aspirations, and children's health. Their findings point to strong cumulative neighbourhood effects on outcomes related to education and cognitive skills, but no statistically significant evidence for effects on child health. Based on this, I hypothesise the existence of a multigenerational neighbourhood effect, according to which:

Hypothesis 3: Exposure over two consecutive generations ($NEIGH_{CURR}$ and $NEIGH_{PAST}$) to neighbourhood deprivation negatively affects offspring's outcomes to a greater extent than exposure to deprivation in just a single generation.

This hypothesis allows me to explore whether continued neighbourhood deprivation over two following generation overall results in worst outcomes, but it does not allow me to discern whether there is a significant difference between individuals with such long-lasting experiences of deprivation and individuals with diverse neighbourhood histories. To explore this last question, I focus on different trajectories of neighbourhood experiences across generations. The study of trajectories has been previously integrated in studies of social mobility across generations (Aboim and Vasconcelos, 2009; Chan and Boliver, 2013; Wightman and Danziger, 2014; Ziefle, 2019). Authors have compared, for example, how youth characterised by different trajectories of family income or educational achievement across two generations fare when it comes to their own educational outcome (Wightman and Danziger, 2014). I perform a similar analysis, but focusing instead on trajectories of multigenerational spatial mobility. More specifically, in alignment to previous literature (Alvarado and Cooperstock, 2021) and based on their multigenerational neighbourhood trajectories I classify children in four groups (stable deprived, upward, downward and stable non-deprived) and assess whether and how belonging to a family characterised by one or the others spatial mobility trajectory influences cognitive and socio-emotional outcomes. My final prediction is:

Hypothesis 4: Cognitive and socio-emotional outcomes of youth characterised by a stable deprived trajectory will be worse than those of youth characterised by other spatial mobility trajectories.

4.2. Data and Methods

In this work, I leverage the longitudinal dimension of the NCDS, exploiting in particular data from Sweep 3 (1974) and Sweep 5 (1991). Information on children's outcomes is taken from a sub-sample of individuals surveyed in 1991. The 1991 NCDS follow-up obtained information not only from the main NCDS sample, but also from the children of one third of cohort members randomly selected (Ferri, 1993).

4.2.1. The Sample

Out of the 15,558 cohort members who were not dead nor emigrated by sweep 5, one-third was randomly selected to participate in the Mother and Child questionnaire (N=5,167). Data from both children whose mother is NCDS cohort member and children whose father is NCDS cohort member (in that case, it is the cohort member's partner, that is the mother of the children, who would answer the main questionnaire) are considered. The sample selection process is showcased in Table 4.1 below.

Table 4.1. Sample Selection

	Sweep 5	**Randomly Selected for Child Interview**
All known NCDS cohort member	16,455	-
NCDS members not dead, not emigrated	15,558	5,167
Traced	13,441	4,482
Responded to survey	11,407	3,708
Found to have kids (responded to MC questionnaire)		2,590 For a total of N=4,282 children

Table 4.2 below displays the data structure, including details of the sweep in which each variable for this analysis was collected.

Table 4.2. Data structure

Generation	**First Generation**	**Second Generation**
Year of Data Collection	1974	1991
Age (of the parent)	16	33
Children Outcomes		
Cognitive Skills		X
Socio-Emotional Behaviour		X
Exposure		
Neighbourhood of residence	X	X
Covariates		
Sex	X	X
Parental Education	X	X
Household Income	X	X
Household Size	X	X
Household Tenure: Owned vs Not	X	X
Area: Urban vs. Rural	X	X
Region: England and Wales vs. Scotland	X	X
Age of Mother at Birth	X	
Cognitive Skills	X	
Parental Health		X
Parental Marital Status		X
Child Age		X

Notes: an "X" indicates that the variable was measured in the corresponding time period. Information related to household characteristics during the first generation (i.e. parental education, household income etc.) refer to the offspring's grand-parents characteristics.

4.2.2. Measures

Cognitive Skills. The measure of cognitive skills derives from the Picture Vocabulary Test, a well-known indicator of children's cognitive functioning (Dunn & Markwardt, 1970). The PPVT is an individually administered test of hearing vocabulary which contains 175 test items arranged in order of increasing difficulty. Each item has four simple, black and white illustrations arranged in a multiple-choice format. The subject's task is to select the picture considered to best illustrate the meaning of a stimulus word presented orally by the examiner. The test is designed for persons between the ages of 2.5 and 40 years and is administered to NCDS kids who are at least 4 years old. Since age plays a critical role in the extent to which kids are able to reach a specific top value, I age-standardize this outcome.

Socio-Emotional Behaviour. As a measure of socio-emotional behaviour, I combine two different measures, the Behavioural Problem Index (BPI, Zill and Peterson, 1986) and the Rutter Scale (Rutter, 1967). Mothers complete one or the other depending on their children's age. For children who are over 4 years and under 7 years old, mothers complete the BPI scale. These two scales have been widely used in the literature and have shown high comparability

(Fombonne, 1989). The BPI is based on items from Zill and Peterson's (1986) adaptation of the Child Behavior Checklist developed by Achenbach and Edelbrock (1981). This asks for mothers' ratings of children in areas of problem behaviour such as: hyperactivity, anxiety, dependency, depression, and aggression. Mothers are presented with a series of behaviours (i.e. "your child has sudden changes in mood or feelings" and respond whether this is "often true", "sometimes true", "not true"). For each item denoting a behavioural outcome, "Not true" is coded as 1 and "Sometimes True" and "Often True" as 0, so that higher scores indicate a lower level of behaviour problems. For children who are at least 7 years, mothers complete a rating based on the Rutter Scale (1967). The Rutter scale includes 18 items that similarly investigate children's behavioural dimensions such as hyperactivity, anxiety, depression, and aggression. Example items are "Child often destroys own or other's property" and "Child appears miserable, unhappy, tearful". Mothers respond whether this "certainly applies", "applies somewhat", "does not apply". For each item denoting a behavioural problem, "does not apply" is coded as 1 and "applies somewhat" and "certainly applies" as 0, so that higher scores indicate a lower level of behaviour problems. Finally, I rescale both scores over a 0-5 scale and combine them to create an overall score of socio-emotional behaviour. As for cognitive skills, considering the relevance of age in child socio-emotional development, I age-standardize this outcome.

Neighbourhood Context. The main variables of interest in this analysis are the measures of neighbourhood disadvantage at two points in time. As in previous chapters, I use the Townsend Index of deprivation (Townsend et al.,1988). Information on the census tract of residence is available at two relevant time points. I measure the neighbourhood deprivation characterising the area in which the offspring are growing up during the second generation ($NEIGH_{CURR}$) by exploiting information on the neighbourhood where the family is residing in 1991, at the same time in which information on children outcomes is also measured. I measure neighbourhood deprivation during the first generation ($NEIGH_{PAST}$) by exploiting information available in 1974, when the parent, who was a NCDS cohort member, was 16 years old.

To test the first three hypotheses, I use the Townsend index as a continuous variables, coded in such a way that increasing values of the index mark increasing levels of deprivation. The index is standardized on the sample[2].

[2] In order to make sure that the effect is not driven by the cohort evolution characteristics, I also perform the same analysis keeping the raw index value. Results do not significantly change, in both the OLS and RWR specifications.

To test the final hypothesis, I create four specific trajectories of neighbourhood disadvantage, based on population quintiles of neighbourhood deprivation. Table 4.3 shows how the empirical sample is spread across population quintiles of neighbourhood deprivation. The sample is overall well spread across population quintiles, although it is important to notice that $NEIGH_{PAST}$ has many more missing values than $NEIGH_{CURR}$.

Table 4.3. Empirical sample size by deprivation quintiles in the two generations

VARIABLES	(4) $NEIGH_{PAST}$.	(5) $NEIGH_{CURR}$.
Q1 – less deprived	622	914
Q2	651	951
Q3	718	904
Q4	738	805
Q5 – more deprived	885	699
Tot.	3,614	4,273

Notes: missing information on $NEIGH_{PAST}$=668; missing information on $NEIGH_{CURR}$=9. Quintiles of neighbourhood deprivation computed at the population level.

Relying upon these measures, I code the trajectories as:

- Stable Deprived: individuals who, during both generations (both $NEIGH_{PAST}$and $NEIGH_{CURR}$), resided in one of the two most deprived neighbourhood deprivation quintiles;
- Upward: individuals who, during the first generation ($NEIGH_{PAST}$) resided in one of the two most deprived neighbourhood deprivation quintiles but during the second generation ($NEIGH_{CURR}$) resided in one of three least deprived neighbourhood quintiles;
- Downward: individuals who, during the first generation ($NEIGH_{PAST}$) resided in one of three least deprived neighbourhood quintiles but during the second generation ($NEIGH_{CURR}$) resided in one of the two most deprived neighbourhood deprivation quintiles;
- Stable Non-Deprived: individuals who, during both generations (both $NEIGH_{PAST}$and $NEIGH_{CURR}$), resided in one of three least deprived neighbourhood quintiles.

I choose this grouping configuration since it well-aligns with previous works in the US (Alvarado and Cooperstock, 2021) and it also seems reasonable based on the fact that individuals in Q3 supposedly more likely to feel living in a higher quality, rather than purely disadvantaged areas. Nonetheless, I perform some robustness checks to test whether opting for a different grouping choice (three most deprived vs. two least deprived) changes my results. As shown in Appendix B, table B2, this does not seem to affect findings.

Covariates. A number of background characteristics are measured for both generations, while some are only available in either one or the other. A continuous measure of family income is included in both generations. Parental education is coded in both generations as the highest between mother and father and as an ordinal variable with three categories, ranging from low to high. However, such variable relies on different measures depending on the generation. In the first generation (which corresponds to children's grandparents' education), I code it based on years of education. No qualification, i.e. individuals leaving education before 15 years old, is coded as "low education", leaving education between 15 and 18 years old is coded as "medium education", leaving education after 18 years is operationalised as "high education". In the second generation, instead, it is coded based on the highest education achieved by age 33, with no qualification coded as "low education", CSE/O Level and A Level qualification coded as "medium education" and Higher Qualification and Degree/higher coded as "high education". I include household size coded as a continuous measure. Housing tenure is operationalised in both generations in two dummy variables detailing if the house is owned or not. I add a dummy specifying whether the area is rural or urban as well as regional information (England and Wales vs. Scotland). I include information on the age of mother at birth in the first generation as a continuous variables. I have then a set of measures available only in the second generation, which are all (potentially) exposure-induced (i.e. affected by neighbourhood context in the first generation). These includes marital status (coded as a dummy variable taking values 0 (without partner) or 1 (with partner), self-reported health (coded as an ordinal value ranging from poor to fair to good or excellent) and a continuous indicator of parental cognitive skills[3]. I additionally adjust for parent (cohort member) and child sex as well as for child age. To account for missing data, I use a regression imputation method following the guidelines put forward by the data owner (Silverwood et al., 2021) to impute values for nonresponse. Table 4.4 below presents descriptive statistics with the sample characteristics (prior to the imputation of missing values), by generation.

[3] The NCDS include a measure of the cohort member's verbal ability in 1991 and a measure of cognitive ability resulting from the General Ability Test (GAT) carried out by members at age 16. Since the 1991 verbal ability measure is self-reported and not highly correlated with the GAT score in T0 (Correlation coefficient = 0.19), I do prefer using the GAT score as (potentially) exposure-induced cognitive measure. In practice, I assume indeed that cognitive skills would be likely to be shaped by the neighbourhood in T0, even if similarly measure in T0 and not in T1. It is unlikely indeed that cognitive abilities in T0 would have affected the choice of neighbourhood in T0 (as I would expect this choice to be mostly taken by parents).

Table 4.4. Descriptive statistics

VARIABLES	(1) Mean	(2) SD	(3) Min	(4) Max	(5) N
Outcomes					
Cognitive score	0.00	1.00	-5.01	3.57	2,828
Socio-emotional score	-0.00	1.00	-3.95	1.78	2,622
First Generation					
Deprivation, $NEIGH_{CURR}$	1.86	2.87	-5.00	10.00	3,614
Age of mother at birth	27.45	5.74	14.00	46.00	4,062
Household size	4.98	1.70	1.00	14.00	3,215
Parental education	0.65	0.63	0.00	2.00	3,191
Household income	2.86	0.65	-0.39	5.55	2,912
Tenure: Own	0.47	0.50	0.00	1.00	3,214
Scotland vs. Other	0.10	0.31	0.00	1.00	3,970
Urban vs. Rural	0.75	0.43	0.00	1.00	3,614
Second Generation					
Deprivation,$NEIGH_{PAST}$	-0.19	3.04	-6.00	10.00	4,273
Child Age	6.37	4.00	0	18	4,282
Household size	4.26	1.08	1.00	12.00	4,282
Parental education	1.24	0.59	0.00	2.00	4,259
Household income	4.55	0.90	0.92	10.73	3,642
Tenure: Own	0.75	0.43	0.00	1.00	4,140
Scotland vs. Other	0.09	0.29	0.00	1.00	4,282
Urban vs. Rural	0.71	0.45	0.00	1.00	4,273
Parental cognitive skills	-0.00	1.28	-3.82	2.94	3,260
Parental marital status	0.93	0.26	0.00	1.00	4,124
Parental health	2.83	0.43	1.00	3.00	4,229
Other					
Parent sex	0.61	0.49	0.00	1.00	4,282
Child sex	0.50	0.50	0.00	1.00	4,215

Notes: based on author's calculations on unimputed NCDS data

All outcome variables are age standardized, and have a mean equal to 0 and a standard deviation equal to 1. The value of the neighbourhood deprivation index markedly decreases over time, because between the 1970s and 1990s, the UK population has become on average significantly less deprived so such a change is reflected in the mean value of the index which passes from 1.86 to -0.19. Although this seems like a dramatic change, this is extensively documented elsewhere, as discussed in Chapter 2 (Pitias et al., 2021; Lloyd et al., 2023). Household income, on average, also increases between the first and second generation. I also observe that the value of parental education increases across the two generations, as parents in the second generation become more likely to have a medium to high education as compared to parents in the first generation (that is, the children's grandparents). The level of home ownership also increases

over time, arguably also as a result of policies such as the Right to Buy. The proportion of owners pass from about half of the sample in the first generation on to three quarters of the sample in the second generation.

In Table 4.5, I additionally showcase how the sample characteristics vary depending on the different four trajectories of neighbourhood deprivation. Individuals with a multigenerational history of deprivation tend to have older children than individuals without such a pattern. Two elements emerge at a first glance: parental education and income. Across both generations, these are substantially lower in the case of individuals with a persistently deprived neighbourhood trajectory, as compared to individuals with a persistently advantaged one. Household size is bigger for the stable deprived as compared to the stable non-deprived group, but only in the first generation. With regard to tenure, the percentage of owners is greater in the Stable Non-Deprived category than in the Stable Deprived. Individuals with a history of persistent disadvantage seem to be concentrated in urban areas and, region-wise, in Scotland much more than in other regions. Finally, parental cognitive skills are significantly lower in the Stable Deprived group than in all the other groups.

Table 4.5. Descriptive statistics by trajectory of neighbourhood deprivation across the two generations

	Stable Deprived		Downward		Upward		Stable Non-Deprived	
VARIABLES	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Outcomes								
Cognitive score	-0.22	1.02	-0.04	1.00	0.04	0.90	0.19	0.99
Socio-emotional score	-0.14	1.02	0.04	1.05	0.05	0.95	0.14	0.95
Parent Generation								
$Deprivation, NEIGH_{PAST}$	4.90	1.80	-0.06	1.46	4.14	1.55	-0.37	1.43
Age of mother at birth	27.70	6.01	26.40	5.60	27.96	5.92	27.40	5.45
Household size	5.56	2.02	4.95	1.70	5.00	1.80	4.68	1.34
Parental education	0.43	0.56	0.69	0.60	0.58	0.58	0.80	0.66
Household income	2.68	0.56	2.87	0.65	2.83	0.67	2.99	0.63
Tenure: Own	0.18	0.38	0.56	0.50	0.33	0.47	0.67	0.47
Scotland vs. Other	0.23	0.42	0.02	0.14	0.17	0.38	0.03	0.16
Urban vs. Rural	0.91	0.28	0.73	0.45	0.86	0.35	0.62	0.49
Child Generation								
$Deprivation, NEIGH_{CURR}$	3.65	2.06	2.39	1.59	-1.88	1.43	-2.24	1.36
Child Age	7.90	4.15	6.76	4.07	6.46	3.89	5.61	3.70
Household size	4.38	1.21	4.36	1.05	4.23	0.93	4.21	1.08
Parental education	0.98	0.58	1.17	0.58	1.26	0.55	1.39	0.57
Household income	4.33	0.89	4.48	0.86	4.66	0.89	4.64	0.91

Tenure: Own	0.49	0.50	0.67	0.47	0.90	0.30	0.88	0.33
Scotland vs. Other	0.22	0.41	0.03	0.18	0.15	0.35	0.03	0.16
Urban vs. Rural	0.87	0.34	0.90	0.30	0.69	0.46	0.58	0.49
Parental cognitive skills	-0.66	1.14	-0.11	1.34	0.01	1.21	0.31	1.21
Parental marital status	0.86	0.34	0.90	0.30	0.96	0.20	0.95	0.22
Parental health	2.75	0.50	2.84	0.39	2.88	0.35	2.88	0.35
Other								
Parent sex	0.64	0.48	0.59	0.49	0.57	0.49	0.60	0.49
Child sex	0.51	0.50	0.55	0.50	0.51	0.50	0.49	0.50
N	798		432		822		1,553	

Notes: based on author's calculations on unimputed NCDS data

4.2.3. Empirical Strategy

I assess the effect of $NEIGH_{CURR}$, $NEIGH_{PAST}$and the cumulative $NEIGH_{CURR} + NEIGH_{PAST}$ by using two different specifications.

First, I use standard OLS techniques according to the following equation:

$$Y = \beta_0 + \beta_1 * NEIGH_{CURR} + \beta_2 * NEIGH_{PAST} + X\beta + \varepsilon,$$

With Y_i representing the outcome of interest (cognitive skills or socio-emotional behaviour), which is regressed on the current neighbourhood ($NEIGH_{CURR}$), the past neighbourhood ($NEIGH_{PAST}$), with $X\beta$ representing the vector of all other covariates previously described. Relatedly, I then also estimate the sum of these two coefficients ($\beta_1 + \beta_2$), which represents the combined, additive, effect of the two neighbourhood environment (Sharkey and Elwert, 2010, 2011).

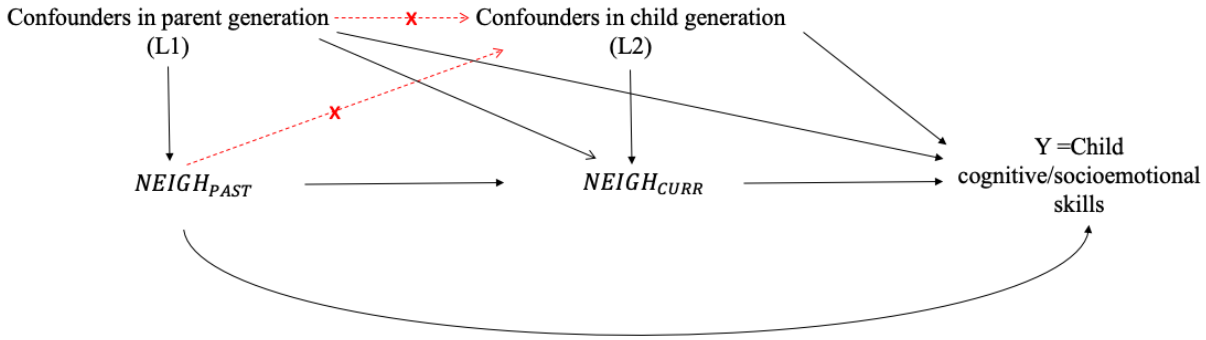
In a second step, I adopt a Regression with Residuals (RWR) approach. Under certain assumptions (Wodtke and Almirall, 2017; Wodtke, 2018; Wodtke et al., 2020; Zhou and Wodtke, 2019), RWR allows to obtain unbiased treatment effects when treatments (that is, in my case, exposure to neighbourhood deprivation) and confounders vary over time, or across generations as in my empirical application. Overall, the main advantage of RWR is that it solves issues related to exposure-induced confounders although it is important to note that some limitations, especially when it comes to control for unobserved confounding, still apply.

Standard OLS techniques usually adjust for individual and background confounders but, in longitudinal settings, such covariates can be endogenous to previous treatments, posing a number of challenges when it comes to estimating causal treatment effects that endure over time. On the one hand, conditioning naively on post-treatment confounders can create overcontrol bias as it blocks the effect of the treatment on the outcome that passes through these

variables (Robins, 1986; 2000). On the other hand, conditioning naively on post-treatment confounders can lead to collider-stratification bias when these variables are affected by unobserved determinants of the outcome (Robins, 1986; 2000). Several modelling approaches can properly adjust for time-varying controls while avoiding biases and have been previously used in neighbourhood research, such as inverse probability of treatment weighting (IPTW) (Sharkey and Elwert, 2010, 2011), g-methods, and the SNMMRWR (Lauen and Gaddis, 2013). In comparison to such weight-based approaches, however, RWR is relatively efficient, can be used with continuous treatment variables (rather than just binary ones, as is the case of MSM with IPTW, as used by Sharkey and Elwert, 2010, 2011) and, except in cases of severe model misspecification, more accurately predicts the outcome variable (Wodtke, 2018).

RWR eliminates biases by residualising the exposure-induced confounders with respect to the observed past before including them in the regression model for the outcome. The directed acyclic graph (DAG) below (Fig. 4.1) depicts the logic of RWR applied to this case, showing how the residualisation of past time-varying confounders with respect to the observed past purges them of their association with prior exposures (red dotted lines).

Figure 4.1. Directed acyclic graph (DAG) of regression-with-residuals approach



Note: DAG adapted from Wodtke, 2018

Overall, the RWR model relies on the combination of two different models. The first specification relates to the second treatment $NEIGH_{CURR}$ and estimates the conditional mean of the $NEIGH_{CURR}$ given the first treatment $NEIGH_{PAST}$ and the baseline confounders L1. The second specification is for the conditional mean of the outcome Y given the treatment $NEIGH_{PAST}$, the treatment $NEIGH_{CURR}$, the baseline confounders L1, and finally, other relevant confounders L2, which may be treatment-induced confounders (for example, parental education or parental health, which are likely to be affected by $NEIGH_{PAST}$). All in all, this model is similar to a conventional linear regression, except that it subsumes another model for E(L2|L1, $NEIGH_{PAST}$,), which is used to residualise the treatment-induced confounders with

respect to the observed past. Empirically, such approach is implemented in two steps. The first step consists in estimating the models for the treatment $NEIGH_{CURR}$ and treatment-induced confounders L2. In the second step, the outcome is regressed over the treatments, the baseline confounders and the residualised treatment-induced confounders.

For both OLS and RWR specifications, I present two different models. In the first one, I only include $NEIGH_{CURR}$. In the second one, I add $NEIGH_{PAST}$ and the estimated cumulative effect of $NEIGH_{CURR}$ and $NEIGH_{PAST}$, defined as the sum of the two neighbourhoods environments. Across all specifications, standard errors are clustered at the family level.

To test my final hypothesis and compare youth with different trajectories of past neighbourhood disadvantage, I rely solely on OLS techniques since RWR specifications are not applicable and I focus on estimating the coefficient of a measure of neighbourhood trajectory variable ($NEIGH_{TRAJECTORY}$) according to the following equation:

$$Y = \beta_0 + \beta_1 * NEIGH_{TRAJECTORY} + X\beta + \varepsilon$$

4.3. Results

In Table 4.6 on the next page, I showcase the effects of living in a disadvantaged neighbourhood, during each specific generation and in a cumulative perspective on cognitive skills.

Table 4.6. Multi-generational neighbourhood effects on cognitive skills

	Cognitive Skills			
	OLS		RWR	
VARIABLES	Model 1	Model 2	Model 1	Model 2
$NEIGH_{CURR}$	-0.043	-0.028	-0.039	-0.025
	(0.024)	(0.024)	(0.027)	(0.025)
$NEIGH_{PAST}$		-0.059*		-0.084**
		(0.026)		(0.025)
$NEIGH_{CURR}$+ $NEIGH_{PAST}$		-0.087**		-0.109***
		(0.03)		(0.034)
Constant	0.005	0.003		
	(0.236)	(0.236)		
1st Generation Confounders (L1)	X	X	X	X
2nd Generation Confounders (L2)	X	X	Residualised	Residualised
Observations	4,282	4,282	4,282	4,282

Notes: Sample includes respondents whose children were interviewed in Sweep 5 of National Child Development Study, 1991. The outcome is age-standardized. Results are combined estimates from 50 imputations. Standard errors for RWR approach are based on block bootstrap with 200 replications at the family level. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1.

My first hypothesis was that $NEIGH_{CURR}$ negatively affects children's cognitive skills. However, findings do not confirm hypothesis H1a. The coefficient of $NEIGH_{CURR}$ is not statistically significant levels in any of the models. In contrast, results show that the effect of living during in a deprived neighbourhood during the first generation ($NEIGH_{PAST}$) on youth cognitive skills is statistically significant, which confirms hypothesis H2. Exposure to a one standard deviation increase in the deprivation of $NEIGH_{PAST}$ reduces children's cognitive skills by between 0.06 (OLS) and 0.08 (RWR) (cognitive skills range from -5.01 to 3.57). Finally, the cumulative effect of sustained exposure to neighbourhood deprivation across the two generations is also significant[4]. According to these estimates, sustained multigenerational exposure to a neighbourhood one standard deviation above the mean of the deprivation index is estimated to reduce youth cognitive skills by between 0.09 (OLS) and 0.11 (RWR).

In the next step, I disentangle the extent to which the contrasting four trajectories of neighbourhood deprivation (Stable Deprived, Downward, Upward, Stable Non-Deprived) affect youth cognitive outcomes. Table 4.7 summarises results, which are also showcased in figure 4.2. Full regression results are presented in Table B1 in the Appendix B.

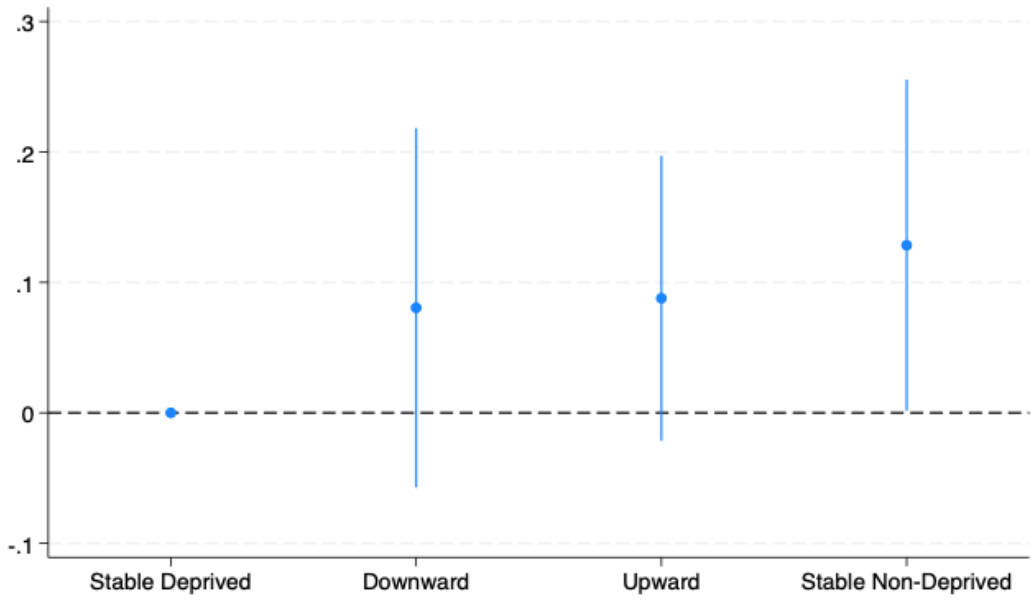
Table 4.7. Trajectories of multigenerational effects on cognitive skills. Two most deprived vs. Three less deprived neighbourhood quintiles

VARIABLES	Cognitive skills
Trajectory/Ref: Stable Deprived	
Downward	0.081
	(0.070)
Upward	0.088
	(0.056)
Stable Non-Deprived	0.128*
	(0.064)
Constant	-0.089
	(0.240)
Observations	4,282

Notes: Sample includes respondents whose children were interviewed in Sweep 5 of National Child Development Study, 1991. The outcome is age-standardized. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1.

[4] I also test an interaction term between the two neighbourhood values, but in all specifications, this is not statistically significant (OLS, β=- 0.003, p=0.983. RWR, β=0.002, p=0.506). This is, in my view, coherent with my theoretical expercations. Since $NEIGH_{PAST}$ and $NEIGH_{CURR}$ are temporally consequential, there is no reasons to expect an interaction effect, meant as a causal process whereby the effects of $NEIGH_{CURR}$ on the outcomes would be dampened or amplified by residence in an advantaged versus disadvantaged neighbourhood in the previous generation ($NEIGH_{PAST}$). Rather, I would expect this condition to favour an effect mediation, meant as the operation of a causal chain for which differences in neighbourhood context in the previous generation $NEIGH_{PAST}$ engender differences in neighbourhood context in the children generation $NEIGH_{CURR}$, which in turn engender differences in children cognitive or socio-emotional behaviour. Future research should thus test this additional hypothesis.

Figure 4.2. Multi-generational neighbourhood disadvantage and cognitive skills



As compared to youth whose neighbourhood trajectory is Stable Deprived, youth with all other trajectories report higher cognitive skills. However, the difference between youth with a Stable Deprived history of neighbourhood deprivation and both Downward and Upward trajectory is not statistically significant. In contrast, the difference between individuals whose family has lived across both generations in the two most deprived quintiles and those whose family has instead consistently lived in the top three non-deprived areas is statistically significant at $p<$ 0.05.

In table 4.8, I present results concerning socio-emotional behaviour.

Table 4.8. Multi-generational neighbourhood effects on socio-emotional behaviour

	Socio-emotional Behaviour			
	OLS		RWR	
VARIABLES	Model 1	Model 2	Model 1	Model 2
$NEIGH_{CURR}$	-0.060*	-0.050^{+}	-0.053*	-0.047^{+}
	(0.026)	(0.027)	(0.027)	(0.027)
$NEIGH_{PAST}$		-0.039		-0.05^{+}
		(0.027)		(0.026)
$NEIGH_{CURR}$+ $NEIGH_{PAST}$		-0.087**		-0.097**
		(0.03)		(0.031)
Constant	-1.186***	-1.189***	-0.073	-0.081
	(0.296)	(0.296)	(0.052)	(0.052)
1st Generation Confounders (L1)	X	X	X	X
2nd Generation Confounders (L2)	X	X	Residualised	Residualised
Observations	4,282	4,282	4,282	4,282

Notes: Sample includes respondents whose children were interviewed in Sweep 5 of National Child Development

Study, 1991. The outcome is age-standardized. Results are combined estimates from 50 imputations. Standard errors for RWR approach are based on block bootstrap with 200 replications at the family level. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1

In the first model (Model 1) across both the OLS and RWR specifications, exposure to deprivation in the $NEIGH_{CURR}$ negatively affects socio-emotional behaviour, confirming hypothesis H1b. In the OLS-Model 2, which adds information about past neighbourhood disadvantage, I observe that the strength of the coefficient of $NEIGH_{CURR}$ weakens, while the effect of $NEIGH_{PAST}$ is instead non statistically significant. However, in the RWR-Model 2, even when information about past neighbourhood deprivation is included, both $NEIGH_{CURR}$ and $NEIGH_{PAST}$ are statistically significant, although only at p<0.1 level. Overall, across both specifications the coefficient of the exposure over two successive generations has a strong negative effect on socio-emotional behaviour[5]. Residing in a standard deviation more deprived area both in $NEIGH_{CURR}$ and in $NEIGH_{PAST}$ results in a youth' decrease in socio-emotional behaviour of about 0.09.

In table 4.9 and figure 4.3 are presented the results concerning the trajectories of neighbourhood environment for socio-emotional behaviour. Full results are included in Appendix B, Table B1. Findings align with those obtained for cognitive skills.

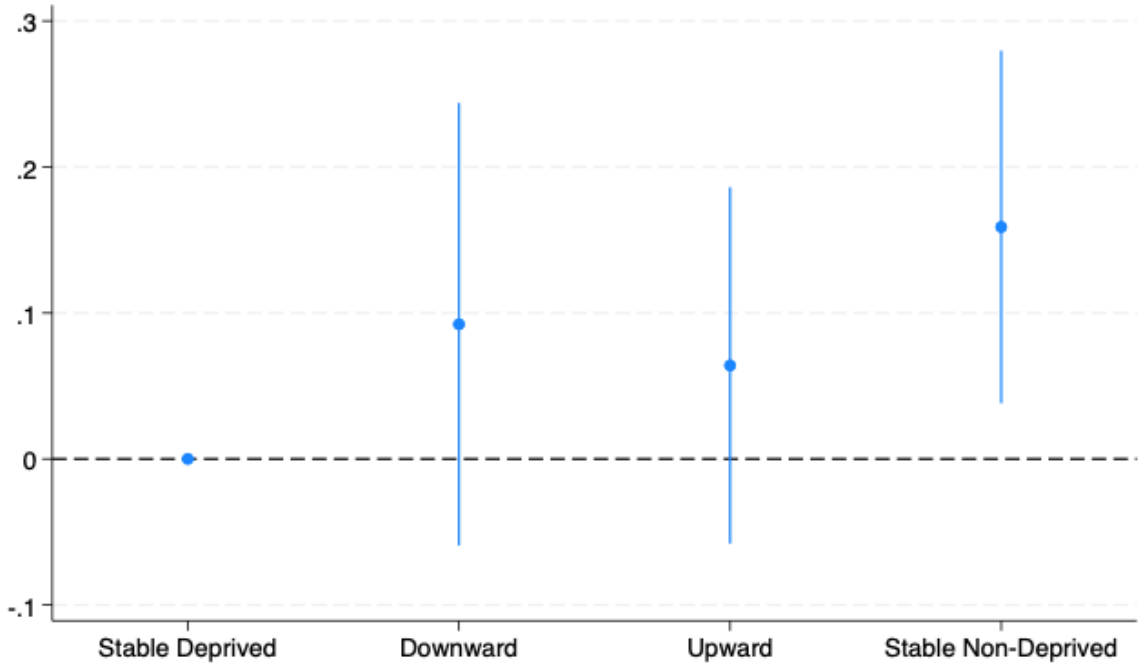
Table 4.9. Trajectories of multigenerational effects on cognitive skills. Two most deprived vs. Three less deprived neighbourhood quintiles

VARIABLES	Socio-emotional Behaviour
Trajectory/Ref: Stable Deprived	
Downward	0.092
	(0.077)
Upward	0.064
	(0.062)
Stable Non-Deprived	0.159**
	(0.061)
Constant	-1.307***
	(0.297)
Observations	4,282

Notes: Sample includes respondents whose children were interviewed in Sweep 5 of National Child Development Study, 1991. The outcome is age-standardized. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1.

[5] As in the case of cognitive skills, I also test the existence of an interaction effect. Again, this is not supported (OLS, β= -0.000, p=0.960. RWR, β=0.002, p=0.315).

Figure 4.3. Multi-generational neighbourhood disadvantage and socio-emotional behaviour



As compared to youth whose neighbourhood trajectory is Stable Deprived, youth with all other trajectories showcases less negative socio-emotional behaviour. However, also in this case, the only statistically significant (p<0.05) difference is between the reference category (youth whose family has persistently lived in deprived areas) and youth whose family has consistently lived in non-deprived areas.

4.4. Discussion and conclusion

The persistence of social institutions is one of the pathways through which inequality is reproduced over time (Mare, 2011). Neighbourhoods are one example of such social institutions, as they do constitute indeed meso-level ecologies within which individuals live and develop, in relation to their community and the ruling socio-cultural norms.

In this chapter, I expanded on previous literature on neighbourhood effects by exploring the existence of long-term, multigenerational, residential effects and by looking into how family trajectories of neighbourhood disadvantage shape youth development. First, I hypothesised, coherently with the conventional neighbourhood literature, that the neighbourhood where individuals grow up ($NEIGH_{CURR}$) affects their cognitive skills and socio-emotional behaviour. While I find confirmation for an effect, although weak, of the current neighbourhood on socio-emotional behaviour, I fail to find any statistically significant effect on cognitive skills. Overall,

this seems in line with the work carried out by other authors during the 1990s in the UK (McCulloch and Joshi, 2001; McCulloch, 2006), according to which neighbourhood environments are more relevant for non-cognitive than cognitive development. Other types of environmental influences, such as families or schools, might indeed matter more for cognitive outcomes.

My second hypothesis was related to the relevance through which the effect of past neighbourhood environments ($NEIGH_{PAST}$) might exert a intergenerational effect on youth outcomes. I find confirmation that exposure to neighbourhood deprivation in the previous generation affects cognitive skills in the next one, consistent with findings from the United States (Sharkey and Elwert, 2010). However, in this case, findings for socio-emotional behaviour are statistically less robust since the effect of $NEIGH_{PAST}$ is only significant at $p<0.1$. In order to better disentangle such evidence, future analyses should be carried out concerning the mechanisms that might mediate the effect of $NEIGH_{PAST}$ on future outcomes. For example, analysing the extent to which the transmission of disadvantaged neighbourhood environments across generations passes through the indirect transmission of residential characteristics, educational advantage, socio-economic or health status, and how each of these mechanisms contribute to explain these results.

Finally, the remaining two hypotheses are confirmed. Findings, indeed, highlight the cumulative, multigenerational and persistent nature of neighbourhood effects over time. In line with H3, exposure over two consecutive generations to neighbourhood deprivation negatively affects both cognitive and socio-emotional outcomes. At the same time, I also find evidence for H4, according to which youth with a trajectory of consistent neighbourhood deprivation experience significantly different and worse outcomes than youth a different trajectory. In particular, I observe a statistically significant difference between youth characterised by a stable deprived trajectory, as compared to youth with a stable non-deprived trajectory. Overall, both results are consistent with theories of cumulative disadvantage, based on which sources of individual advantage, including living in a disadvantaged or advantaged neighbourhood environment, compound over each other and over time, which results in widening inequality over time (DiPrete and Eirich 2006; O'Rand 1996).

Methodologically, I try to combine standard OLS techniques with a RWR modelling approach, which allows me to be more confident about the robustness of my results. Nonetheless, I still cannot make any causal claim, since such estimation does not take into consideration unobserved confounding. Further sensitivity analyses should be carried out to remove this additional source of uncertainty.

Chapter 5

Mind the gap: The interplay between genes, neighbourhood context and educational outcomes

Introduction

Decades of research have focused on how family socio-economic status affects individual educational outcomes (Boudon, 1974; Blau and Duncan, 1967; Lareau, 2003; Goldthorpe and Jackson, 2008; Duncan and Murnane, 2011; Bernardi and Ballarino, 2016). Children's genetic endowment also shapes educational attainment (Branigan et al., 2013; Silventoinen et al., 2020) and the advent of large-scale molecular genetic data has thus fostered the integration of genes linked to educational attainment into social stratification research (e. g. Conley et al., 2015; Liu, 2018; Mills and Tropf, 2020; Rietveld et al., 2013; Harden, 2021). Recently, sociologists have started to directly assess the role of genetic inheritance in the intergenerational transmission of socio-economic status (SES) (Liu, 2018) and the interaction of genes and socioeconomic contexts (e. g. Conley et al., 2015; Baier and Lang, 2019; Erola et al., 2021; Guo and Stearns, 2002; Lin, 2020).

The Scarr-Rowe hypothesis (Rowe, Jacobson and Van Den Oord, 1999; Scarr-Salapatek, 1971) provides the typical expectation around such gene-environment interactions (GxE), suggesting that genetic potential for the development of cognitive abilities can be more fully expressed in high as compared to low SES families. An established line of research has tested this hypothesis (Baier and Lang, 2019; Erola et al., 2021; Figlio et al., 2017; Guo and Stearns, 2002; Lin, 2020), arguing that advantaged families provide resource-rich environmental conditions that are tailored to children's needs, thus facilitating the realization of genetic influences on IQ and educational achievement. Yet, few of these studies have gone beyond dimensions of family SES as indicator for children's environmental (dis-)advantage (for an example, see Baier and Van Winkle, 2020, who look at childhood family structure). Overall, most works have been relying on the assumption that the "E" stops at the family's front door.

However, we know that neighbourhood characteristics, in addition to family socio-economic background, are central for understanding differences in cognitive abilities, educational aspiration, achievement, and their intergenerational transmission (e. g. Kauppinen, 2008; Mijs and Nieuwenhuis, 2022; Sharkey and Faber, 2014; Sykes and Musterd, 2011; De Vuijst and Van Ham, 2019; Wodtke, Harding and Elwert, 2011). Socialization patterns within the neighbourhood, the quality of local institutions and the level of neighbourhood collective efficacy are all critical drivers of adolescents' education-related outcomes and thus might also affect the role of genes.

In this chapter, I address the following question: does neighbourhood socio-economic conditions moderate genetic effects on cognitive abilities, academic motivation and achievement? Neglecting the neighbourhood dimension within the GxE inquiry has relevant implications. Theoretically, it means that we might be underestimating the importance of the environmental influence on educational outcomes. Practically, such insights may be essential when designing policies to mitigate disadvantage across the life course and the reproduction of social inequalities in education.

I draw, as for the other chapters, on the UK 1958 birth cohort or National Child Development Study (NCDS). The NCDS contains information on neighbourhood socio-economic environment, socio-economic family background and school quality, combined with molecular genetic information. As an indicator of individual genetic endowment, I leverage so-called polygenic scores (PGSs), which represent vectors of aggregate individual genetic effects predictive of educational attainment (Lee et al., 2018).

I bring several contributions to the GxE field. First, I add to the theoretical discussion about the shape of the expected interaction between genes and socio-economic context by introducing new mechanisms linking the neighbourhood context to cognitive abilities, academic motivation and achievement. Here, the inclusion of academic motivation in this investigation, next to cognitive abilities and educational achievement, is also an innovative feature. Methodologically, I present results from the main NCDS sample as well as from a subsample of individuals living in social housing. I exploit the fact that, at the time, social housing accommodations in the UK were assigned based on a time-only criteria (first come first served basis). This limited applicants' freedom to choose the neighbourhood they lived in, hence reducing neighbourhood selection (Van Ham and Manley, 2009). Neighbourhood selection, the fact that individuals choose where to reside, is still one of the most relevant methodological challenges in neighbourhood studies, as it prevents the identification of a neighbourhood causal effect (Dietz, 2002; Graham, 2018). In addition to that, by adopting this strategy, I can also mitigate concerns about residential sorting based on the genome (Abdellaoui et al., 2018), the fact that individuals with higher genetic predispositions for educational attainment tend to move into more advantaged environments, which might bias GxE estimates (Laidley, Vinneau and Boardman, 2019). Finally, this is the first analysis that provides robust empirical evidence that the importance of genes for academic motivation and educational achievement is lower for individuals growing up in high-SES compared to low-SES neighbourhoods in the UK. I unravel a relevant role played by the neighbourhood in

compensating for pre-existing disadvantage, with relevant implications for educational inequalities.

In the following section, I provide some background in respect to theory and empirical studies on gene-environment interactions. I then leverage theories on neighbourhood effects to derive and formulate my hypotheses and I finally provide details about my strategy to deal with neighbourhood selection. Afterwards, I introduce the data and empirical methods. In the final sections, I show and discuss my findings.

5.1. Background

Classic literature in social stratification highlights how different environments represent structural contexts of opportunities and, relatedly, pools of resources available to youth to grow and develop (Blau and Duncan, 1967). The family environment has traditionally been considered the most relevant for shaping youth future outcomes. One of the main theoretical streams in the field, the cultural capital approach, emphasizes that high-SES parents tend to provide their children with more cultural and economic resources than low-SES ones (Bourdieu, 1977; Astone and McLanahan, 1991; Sui-Chu and Willms, 1996; Goshin et al., 2021). Children then convert such resources into better educational performances and higher educational attainment, reproducing existing social inequalities (Jæger and Breen, 2016).

However, in reference to cognitive performance, educational motivation, and achievement, determinants outside the family such as the school as well as the neighbourhood contexts can also take a central role. There are several theoretical reasons for which other-than-family environments, and neighbourhoods in particular, influence and shape individual behaviour and life courses. For example, Pebley and Sastry (2003) elaborate on the role of child and family related institutions, social organization and interaction, as well as the normative environment, which is especially important for the socialization of children, and the labor and marriage markets. Galster (2012) instead subsumed 15 potential causal pathways through which neigbourhoods affect children into the categories social-interactive, environmental, geographical, and institutional mechanisms.

To date, the family, as compared to other environmental dimensions such as schools and neighbourhoods, has taken a prominent role in studies on education in the field of behavioural genetics. These studies have mainly looked at how genetic endowment affects the intergenerational transmission of education. However, with the rising accessibility to more refined molecular genetic data, scholars have increasingly focused on jointly analyzing genetics

and environmental effects. In other words, unpacking if and how individuals tend to respond differently to the same type of environmental stimulus (and in particular the family socio-economic environment) based on their genome (Ritz et al., 2017).

5.1.1. A short introduction to genes and educational achievement

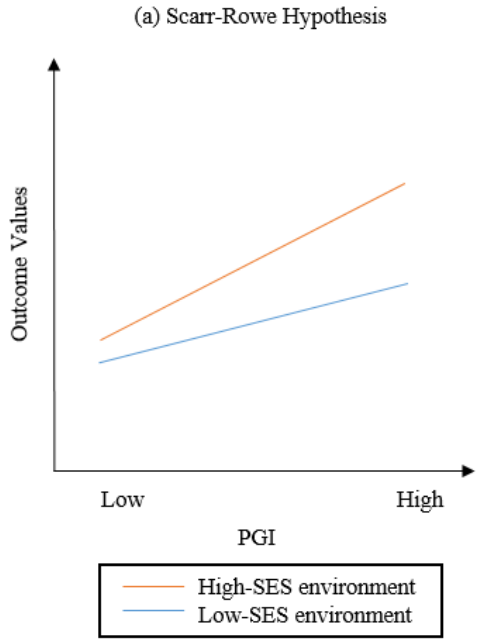
Twin studies indicate that genetic factors represent a substantial source of individual differences, explaining on average ~50% of the variation in human traits (Polderman et al., 2015). This finding also holds for educational outcomes, where genetic endowments overall may account for 40% of the variation in years of education (Branigan et al., 2013; Silventoinen et al., 2020; Wolfram and Morris, 2023). Similarly, the genetic component of scholastic achievement is strongly associated with both cognitive ability and non-cognitive traits (i.e. Krapohl et al., 2014 ; Plomin and Deary, 2015 ; Briley and Tucker-Drob, 2017 ; Greven et al., 2009; Klassen et al., 2018).

One decade ago, the advent of molecular genetic data and the first genome-wide association study (GWAS) on educational attainment helped researchers to go one step further in the exploration of genetic effects on education. Researchers discovered three of the most common kind of genetic variation (specifically, single nucleoid polymorphisms [SNPs]) associated with years of schooling and receiving a college degree (Rietveld et al., 2013). Most recent GWAS found up to around four thousand, due to increased sample sizes (Okbay et al., 2022).The strength of the association between the genetic variants and the outcome can be summarized, for each individual conditioning on their own genetic endowment, in a summary score defined as “polygenic score”. Such scores can be easily included in standard regression models and they have been found to be reliable in predicting educational attainment in entirely independent samples, including in samples that compare one full sibling to another (Domingue et al., 2015; Okbay et al., 2016; Rietveld et al., 2014; Selzam et al., 2017). They have therefore been used in so-called gene-environment (GxE) analyses, aimed at refining the understanding the interplay of genes and environment through various pathways (Kong et al., 2017, Bates et al., 2018).

5.1.2. The Interplay of Genetics and Environment: two competing hypotheses

The most prominent theory in studies that look jointly on genetic and environmental effects is the Scarr-Rowe hypothesis. This investigates the moderating role of socioeconomic environmental context – typically the family SES – on the effect of genes on cognitive ability and education (SRH, Rowe et al., 1999; Scarr-Salapatek, 1971). The SRH builds upon bioecological mechanisms proposed by Bronfenbrenner and Ceci (1999). It argues for the enhancing role of a supportive environment, in alignment with a sociological cultural capital approach, thus enlarging the difference between individuals with higher and lower genetic predispositions. According to the SRH, environments characterized by high SES compared to low SES can boost the development of cognitive abilities, with the marginal effects of living in a high SES environment being greater for those individuals characterized by higher genetic predispositions (see Figure 5.1a below for a visualization of the hypothesis as individual predictions).

Figure 5.1a. Typologies of expected individual predictions based on a polygenic score for a trait and its interaction with socio-economic conditions: The Scarr-Rowe Hypothesis.

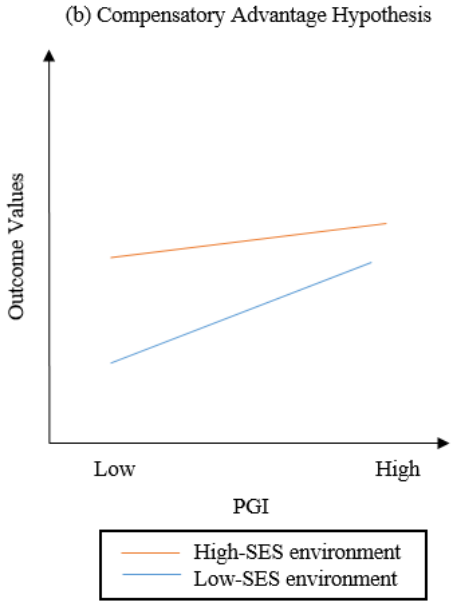


Empirical assessments of the SRH explaining differences in cognitive abilities (e.g. Giangrande et al., 2019; Grasby et al., 2019; Hanscombe et al., 2012; Spengler et al., 2018) or educational achievement (Domingue et al., 2015, Conley et al., 2015; Baier and Lang, 2019, Erola et al., 2021; Isungset et al., 2021; Lin, 2020; Figlio et al., 2017) often confirm the idea. Nonetheless, the increasing amount of research on this topic has also questioned the application and conditions in which this hypothesis applies. Recent studies found no moderation effect of family

SES (i.e. Conley et al., 2015; Isungset et al., 2021; Figlio et al., 2017) or even a negative moderation effect (Domingue et al., 2015; Lin, 2020; Ruks, 2022). Previously, ad hoc explanations have emerged, explaining heterogeneous findings for example based on policy differences on the system level (Tucker-Dropp and Bates, 2015).

As an alternative to the SRH, the Compensatory Advantage Hypothesis (CAH) has derived from the effort of explaining the negative moderating effect of family SES on the enhancement of genetic predispositions. The CAH predicts that environments characterized by high SES compared to low SES still boost the development of cognitive outcomes. However, the marginal return of living in a high SES environment is greater for those individuals characterized by lower genetic predispositions (see Figure 5.1b for a visualization of the hypothesis as individual predictions). Within this framework, higher-SES environmental contexts thus contribute to reduce existing gaps among individuals characterized by higher and lower genetic predispositions.

Figure 5.1b. Typologies of expected individual predictions based on a polygenic score for a trait and its interaction with socio-economic conditions: The Compensatory Advantage Hypothesis.



In order to theoretically explain this hypothesis, authors such as Ghirardi (2022) and Ruks (2022) have related it to the compensatory advantage hypothesis in social stratification (Bernardi, 2014). This theory stresses how high-SES parents use their available resources to compensate for the early disadvantage of their kids. For example, high-SES parents have the financial resources to afford private tutoring lessons (Bernardi, 2014) and are more likely to

successfully challenge unfavorable decisions made by educational gatekeepers (Lareau, 2011). They may make ambitious educational choices irrespective of their children's ability and performance and they have even more incentive to invest in their at-risk children who face the highest chance of educational failure and social downward mobility (Bernardi, 2014).

5.1.3. A theoretical framework on gene × neighbourhood (G×N) effect on cognitive skills, academic motivation and educational achievement

Both the SRH and CAH have so far been investigated in the context of family SES and, although to a lower extent, school quality (Hart et al., 2013; Taylor et al., 2010; Trejo et al., 2018; Harden et al., 2020; Arold et al., 2022). In contrast, none of these hypothesis has been tested in the context of neighbourhood SES, although the neighbourhood literature has posited that living in a higher-SES neighbourhood is typically associated with better cognitive skills and educational outcomes compared to living in a lower-SES one (Sharkey and Faber, 2014).

In the following, I therefore review previous theories on neighbourhood mechanisms (Sampson et al., 2002; Wodtke et al., 2011, Leventhal and Brooks-Gunn, 2000; Sharkey and Faber, 2014) as well as relevant empirical findings to develop hypotheses on how neighbourhood environments might moderate the relationship between individual genetic predispositions and cognitive skills, academic motivation and educational achievement. In other words, I try to assess the extent to which neighbourhood conditions amplify pre-existing inequalities related to genes (in line with the SRH) or rather reduce them (in line with the CAH). From a theoretical point of view, within the GxE field, the Scarr-Rowe hypothesis promotes a logic of enhancement of genetic "potential" for education based on SES. However, by reviewing the channels through which neighbourhoods seem to operate, I do not expect it to theoretically translate.

First, neighbourhoods represent an important environment for socialization, especially during adolescence - in contrast to early childhood - when children start interacting more with their friends and less with their family (Sharkey and Faber, 2014). Adolescents living in high-SES neighbourhoods are more likely to be exposed to successful and inspirational peers and adult role models, who provide examples of the value in reading, problem-solving and attending school (Leventhal and Brooks-Gunn, 2010). I would expect exposure to such positive examples is more likely to provide important indirect stimuli for teenagers characterized by lower, as compared to higher, genetic predisposition. In fact, the neighbourhood would here operate via positive contagion behaviour regarding aspirations and attitudes, potential competition, the

formation of strong or weak ties in social, informational networks and so forth (Galster, 2012), resulting in an overall strong normative environment (Pebley and Sastry 2003).

Second, neighbourhoods represent institutional settings related to families and children concentrating crucial resources for youth development such as schools, libraries, family support centres, care providers and recreation centres (Small and Newman, 2001). Such institutions contribute to socialization, teaching skills or provide complementary services (Pebley and Sastry, 2003). The availability and quality of childcare, for example, both in respect to features such as staff pedagogy and education, are important for parents' investments and children's development (Jencks and Mayer, 1990; Aber et al., 1997). In high-SES neighbourhoods, such institutions tend to be of higher quality as compared to low-SES ones (Pacione, 1997). High-PGS adolescents may exploit the availability of such institutional resources in high-SES neighbourhoods more intensively than low-PGS ones. However, it could also be that such institutional resources are in reality more often used by teenagers who need it the most (Plybon et al., 2003), especially in the case in which they serve the purpose of filling in any potential developmental void left by families.

Finally, social organization and disorganization are crucial for interactions in a neighbourhood, making it easier or harder to establish trust, agree on common values and goals and subsequently exercise social control. In particular, the greater community-level capacity to mobilize on behalf of shared goals in high compared low SES neighbourhoods means that individuals are keener to collectively work to enforce appropriate behaviours and collaborate more in fostering neighbourhood youth development accordingly. This results in greater level of informal surveillance or guardianship (Bellair, 2000) and in a more effective monitoring of teenage peer groups in high-vs-low SES area (Sampson and Raudenbush, 1999; Sampson et al., 2002), which aims at preventing young teenagers from dropping-out from school and adopt delinquent or deviant behaviour. This thus seems to align more with a "protective", rather than individually "enhancing" role of the neighbourhood. Moreover, the relatively low or high degree of so-called collective efficacy (Sampson et al., 2002) can also lead to more stressful experiences in hazardous places in low compared to high SES neighbourhoods (Kling et al., 2007). This is likely to be unequally experienced, with more "at-risk" of lower performances or disadvantages adolescents likely to be bearing the majority of the consequences.

Based on the reviewed mechanisms, considering a stronger normative environment represented by a) positive peer influences in academic motivation possibly combined with potential competition with b) supportive institutional resources and c) stronger collective

efficacy in high-SES vs. low-SES neighbourhoods, I expect a rather equalizing and therefore compensating moderation effect of neighbourhood SES on the outcome.

Previous related empirical evidence also seems to provide support for such a compensatory role of neighbourhood SES in the context of GxE analysis. The literature on the interaction between genes and peer or neighbourhood characteristics on *negatively* connotated behavioural outcomes, such as violent behaviour, drinking or substance abuse (Slutske et al., 2018, Meyers et al., 2013, Pasman et al., 2020; Guo et al., 2015; Guo et al., 2008, Shanahan & Hofer, 2005) finds indeed support for a "protective" role of the neighbourhood via the effect of social norms, cohesion and community stability (Barnes and Jacobs, 2012; Meyers et al., 2013; Sattler et al., 2019). Individuals raised, socialized, and educated in more stable and healthy neighbourhood environments display less pronounced (negative) genetic effects (Boardman et al., 2014).

The work that most closely aligns to this is the one by Cheesman et al (2022). The authors fail to find a significant contribution of the neighbourhood environment on the relationship between individual genes and achievement, but they find evidence for a compensating role of school environment. However, not only these estimates only account for processes of environmental selection based on solely heritable (genetics-driven) characteristics, but the work is also set in the Norwegian context, which is known for being an egalitarian country where almost all social differences tend to be minimized by redistributive policies.

Hence, my final resulting hypothesis concerning the moderating role of the neighbourhood therefore aligns with the CAH such that:

Hypothesis1: High SES compared to low SES neighbourhoods reduce the association between PGS and the outcome.

I devise a unique hypothesis, rather than developing one for each of the three outcomes of interest, since I don't have theoretical reasons for which to believe that neighbourhood mechanisms should operate differently for cognitive skills, academic motivation and (resulting) educational achievement.

5.2. Data and Methods

In this chapter, I leverage information from the Sweep 3 of the NCDS. However, for operationalizing academic achievement I use instead data from Sweep 4 in order to exploit full information on exam results.

The total number of individuals who responded to sweep 3 is N=14,645 individuals. Samples for genetic analyses were retrospectively gathered from the biomedical Sweep in 2002-2004 and, later on, genotyped in different projects and iterations, providing full genetic information for N=6,435 individuals. Individuals were collected as control cases in the WTCCC1, WTCCC2 and T1DGC consortia, with no specific criteria for genotyping, so missing genetic information can be thus assumed to at random. Departing from the full sample of individuals with genetic information, I adopt a number of restrictions to the sample size[6]. Figure C1 and Figure C2 in Appendix C detail the process through which I get to the final sample for, respectively, the full and restricted social housing sample. Complete cases are N=2,056 for the full sample and N=1,016 for the social housing sample[7].

5.2.1. Measures

Cognitive skills. For the measure of cognitive skills at age 16, as detailed in chapter 4, I conduct a Principal Components Analysis (PCA) on the main cognitive ability variables measuring reading and math ability. I extract scores from the first unrotated component for the measure of each child's cognitive ability. Table A1 of Appendix A shows details of this analysis (loadings, eigenvalues).

Academic motivation. To operationalize academic motivation, as described in chapter 4, I create a score by performing a confirmatory factor analysis on eight items related to conscientious school and work habits. The items are: school is a waste of time, I get on with classwork, homework is a bore, it is difficult to keep mind on work, I take work seriously, I don't like school, there is no point planning for the future, I am always ready to help the teacher. Table A2 in Appendix A provides details of the analysis.

[6] In restricting the sample, I only exclude individuals with missing-dependent variables and missing neighbourhood information. Previous works, however, suggest that exposure time is a key for neighbourhood effects research (Chetty, Hendren and Katz 2016). In a separate analysis, I therefore further subdivide our sample into those who have been living in the same area for less, or more than 5 years. Overall, results do not differ from those reported for the full sample. I note that the interaction between neighbourhood quality and the PGS gains in size and significance for the group living in the area since less than five years. Such as result is consistent with findings stressing that individuals may be more sensitive to their surrounding environment during specific stages of the life course and in particular during adolescence (Hicks et al., 2018; Kleinepier and van Ham, 2018; Levy, 2019; Levy, Owens,and Sampson, 2019; Wodtke et al., 2016)

[7] In the Appendix C, I also run the analysis on two larger samples, composed respectively of a) all individuals with non-missing genetic information, neighbourhood information and information on all outcome variables (Table C7 in Appendix C) and b) all individuals with non-missing genetic information and neighbourhood information only (Table C8 in Appendix C). The main results concerning the interaction between PGS and NDI do not significantly vary.

Academic achievement. To measure academic achievement, I use a variable summarizing the general achievement obtained by individuals in public examinations and available within school records. The same measure has been previously used in the literature (Saunders 2006). For all NCDS members, relevant schools were asked to provide details of all CSE, GCE and (in Scotland) SCE examinations entered up to 1978. In this work, I exploit a measure of general achievement developed by the National Children's Bureau (Steedman, 1983), which had the duty to evaluate the school system and youth performance across the country. This measure places individuals at their highest point of achievement on a rising scale of the number of public exams and the grade of various qualifications obtained (CSE, GCE 'O' and GCE 'A' levels plus Scottish equivalents)[8]. For comparability between the scales used in England and Wales and in Scotland, the overall achievement value is rescaled on a value ranging from 0 to 10.

Neighbourhood Deprivation Index (NDI). In this chapter, I create a Neighbourhood Deprivation Index (NDI) score based on the Townsend index (Townsend et al., 1988). Differently from the previous chapter, I create the score is created so that higher values correspond to lower values of deprivation and, hence, higher neighbourhood socio-economic quality. This is done to be able to align with the existing literature on the Scarr-Rowe effect and to better compare the effect of a positive neighbourhood, vs. family, environment. The NDI is standardized on the sample of interest. Overall, a positive value of the NDI coefficient suggests that living in a less deprived (or higher quality) neighbourhood has a positive effect on the dependent variable.

Genetic information: Polygenic score (PGS). To measure genetic predispositions I leverage results from a genome-wide association study (GWAS) of educational attainment (Lee et al., 2018). A GWAS is a series of independent tests for associations of genetic markers (Single Nucleotide Polymorphisms, SNPs) with one outcome of interest. Based on the results from GWASs, polygenic indices (PGS) aggregate genetic associations for a trait into a single score for each individual to predict the outcome in an independent sample. I combine all available genomic data on NCDS respondents (pre-imputed and quality controlled by Artigas

[8] I report here the England and Wales Overall Examination Achievement Scale. The same scale, but with Scottish qualifications, is also used. The scale places individuals at their highest point of achievement from: No graded results at CSE or GCE; One or more 0-lelves at grades 4 or 5 only; One or more CSE at grades 4 or 5 only; One to four CSE at grades 2 to 5, with at least one grade 2 or 3; Five or more CSE at grades 2 to 5, with at least one grade 2 or 3; One to four O-levels, grades A-C, or CSE grade 1; Five or six O-levels, grades A-C, or CSE grade 1; Seven or more O-levels, grades A-C, or CSE grade 1; One A-level pass; Two A-level passes, less than 9 points on UCCA scale; Three or more A-level passes, less than 9 points on UCCA scale; Two A-level passes, none or more points on UCCA scale; Three of more A-level passes, nine or more points on UCCA scale.

et al, 2015 and Davies et al., 2015) and restrict the available SNPs to those in common with the 1000 genomes reference panel. Using PRSice2 (Choi and O'Reilly, 2019), I then created polygenic scores based on the aforementioned EA3 summary statistics (with observations from NCDS removed to guard against overfitting) using a clumping distance of 250kb, clumping r^2 of 0.1 and a pre-specified p-value threshold of 1.

Covariates. The statistical models include a number of covariates. First, as it is standard in genetic research, I control for genetic population stratification including the first 10 Principal Components of genetic data (Novembre et al., 2008). Population stratification refers to allele frequency differences due to systematic ancestry differences, which might proxy cultural differences and cause spurious associations if not adjusted properly. I then add a dummy variable for gender as a dichotomous indicator (male, female), a dichotomous variable for whether individuals live in rural or urban areas, a continuous variable describing household size (ranging from 2 to 6) and a categorical variable for the number of siblings (no siblings/1 to 3 siblings/ 4+ siblings). I also include interactions between the PGS and rural-urban divide, sex and the first 10 Principal Components, to control for confounding of the moderation effect I test for (Keller, 2014). In the final models, I additionally include information on family and school environment. Parental education is operationalized as a dummy variable (low vs. medium-high education) based on the age in which mother and father left education. I categorize as "low-educated" individuals who left school up at the minimum school leaving age (age 15) and as "medium to high educated[9]" those who stayed in education after age 15, taking into account the latest time leaving education between mother and father. School quality is based on school socio-economic status and is operationalized in three categories (low, medium and high) according to the terciles in the distribution of % students in school whose father has a non-manual job[10]. In the UK in particular, the school choice process is bound to school "catchment" areas (Croft, 2004), which means that school and neighbourhood context may overlap. Under this view, I would thus expect the school to most likely represent a channel through which neighbourhood effects may operate. I nonetheless include it in the final model to be able to assess its potential role and the relative consequences on the GxN coefficient.

Table 5.1 below presents descriptive statistics for the sample, comparing the full sample with the social housing sample.

[9] I do not make a distinction between "medium" and "high" level of education due to the very small number of individuals who fall into the latter category.

[10] I prefer the categorization in terciles to aide interpretation in comparison with the dummy of parental education. Nonetheless, I also run all models using the continuous version of this variable to make sure our results are unchanged.

Table 5.1. Descriptive statistics for the two samples

VARIABLES	**Full Sample**	**Social Housing Sample**
Cognitive Skills	0.0394	-0.440
	(1.255)	(1.180)
Academic Motivation	0.0182	-0.0944
	(0.611)	(0.624)
Academic Achievement	4.181	3.203
	(2.570)	(2.310)
Parental Education	0.610	0.460
	(0.488)	(0.499)
School quality	1.810	1.519
	(0.852)	(0.728)
Female	0.508	0.508
	(0.500)	(0.500)
Urban	0.716	0.806
	(0.451)	(0.396)
Household size	4.549	4.684
	(1.084)	(1.132)
Number of siblings	1.101	1.205
	(0.491)	(0.532)
N	2,506	1,016

Notes: data NCDS, Sweep 3 and 4(academic achievement). Mean values, SD in parentheses. The NDI and PGS measures are standardized on the sample.

As compared to the full sample, individuals in the social housing sample have lower mean values of parental education. The level of school quality, however, is only slightly different between the two samples, as in both cases the mean value corresponds to medium-to-high quality schools. The sample is equally split between males and females, and 80% of the social housing sample lives in urban areas, rather than rural ones, in contrast to 71% for the full sample. The average household size is around 4.5 in both sample while the majority of the individuals have between 1 and 3 siblings.

5.2.2. Empirical Strategy

The empirical strategy consists of regression analyses on the three outcomes, cognitive ability, educational motivation and educational achievement. I adopt a stepwise approach by progressively adding the predictors to the models. I start by including the neighbourhood deprivation index. I then include additive controls variables and, in the following step, the polygenic score. I then add the most important variable, the interaction term between the NDI

and the PGS. Later, I include two interaction terms between the PGS and, respectively, parental education and school quality and, finally, all remaining interactive control variables. The final models' equation estimating the interaction between neighbourhood deprivation and PGS is and taking families and schools into account is:

$$Y = \beta_0 + \beta_1 * NDI + \beta_2 * PGS_{edu} + \beta_3 * NDI * PGS_{edu} + \\ + \beta_4 * family_{SES} + \beta_5 * family_{SES} * PGI_{edu} + \\ + \beta_4 * school + \beta_5 * school * PGI_{edu} + X\beta + \varepsilon_i,$$

With Y_i representing the outcome of interest, cognitive ability, academic motivation or academic achievement, which is regressed on the neighbourhood deprivation index (NDI_i), family socio-economic status, school quality, the education PGS and its interaction with the relevant predictors. Note that $X\beta$ represents the vector of covariates mentioned before.

I estimate all models with robust standard errors clustered at LSOA level using STATA 16.0. The decision of clustering at LSOA level is motivated by the fact that, as I identify the neighbourhood at LSOA level, I want to avoid within-cluster correlation biases at the treatment level.

5.3. Results

In this section, I present first the estimates for the full sample and, later on, for the social housing sample. I first focus on the question of whether neighbourhood SES moderates the genetic link to cognitive abilities and I expect a compensatory effect. Table 5.2 estimates the effect of the NDI on children's cognitive abilities.

Table 5.2. R**egression models testing gene × neighbourhood interaction explaining cognitive ability for the full sample in the UK**

Cognitive Ability	(1)	(2)	(3)	(4)	(5)	(6)
Neighbourhood Deprivation Index (NDI)	0.343***	0.121***	0.124***	0.123***	0.122***	0.123***
	(0.024)	(0.026)	(0.025)	(0.025)	(0.025)	(0.025)
Polygenic score (PGS)			0.358***	0.363***	0.256***	0.218**
			(0.026)	(0.056)	(0.065)	(0.068)
NDI × PGS				0.008	-0.010	-0.031
				(0.021)	(0.021)	(0.023)
Parental Education (PE, ref: *low*) *high*		0.333***	0.275***	0.276***	0.290***	0.287***
		(0.048)	(0.047)	(0.047)	(0.047)	(0.047)
PE *high* × PGS					0.163***	0.149**
					(0.047)	(0.047)
School Quality (SQ, ref: *low*)		0.300***	0.289***	0.291***	0.288***	0.294***
medium		(0.057)	(0.055)	(0.055)	(0.055)	(0.055)

high		0.818***	0.746***	0.748***	0.742***	0.733***
		(0.060)	(0.058)	(0.058)	(0.058)	(0.058)
SQ (medium) × PGS						0.067
						(0.058)
SQ (high) × PGS						0.129*
						(0.055)
Control Variables,						
Additive		X	X	X	X	X
Interactive				X	X	X
Constant	0.039	0.208+	0.130	0.128	0.110	0.116
	(0.024)	(0.123)	(0.120)	(0.120)	(0.121)	(0.121)
Observations	2,506	2,506	2,506	2,506	2,506	2,506
R-squared	0.075	0.249	0.302	0.302	0.306	0.307

Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Data: NCDS, Sweep 3. Not shown additive controls include household size, number of siblings and the first 10 principal components of genetic data; interactive controls include gender and urbanization.

I observe that the neighbourhood index is strongly and positively associated with the outcome across all Models, as is the education PGS. In the full model (Model 6), a one standard deviation higher score on the neighbourhood index is associated with 0.12 standard deviation increases in cognitive skills, for individuals whose PGS is equal to 0, net of all other covariates. An increase by a standard deviation in the PGS is associated with an increase in cognitive skills of about 0.20 standard deviations for individuals who score zero on all interacted variables with the PGS and controlling for all the other covariates. However, I find no significant interaction between the neighbourhood index and the PGS. At the same time, I find a confirmation for the Scarr-Rowe hypothesis, which is predominant in the literature both with regard to parental education (0.149, $p<0.01$, Model 6) and school quality (although only for high school quality, 0.129, $p<0.05$, Model 6). Table C1 in the Appendix C includes results of all control variables.

Second, I explore the moderation of neighbourhoods of the gene-academic motivation link. Table 5.3 focuses on this outcome.

Table 5.3. R**egression models testing gene × neighbourhood interaction explaining academic motivation for the full sample in the UK**

Academic Motivation	(1)	(2)	(3)	(4)	(5)	(6)
Neighbourhood Deprivation Index (NDI)	0.083***	0.044**	0.045**	0.046**	0.046**	0.046**
	(0.012)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Polygenic score (PGS)			0.092***	0.072**	0.024	0.015
			(0.013)	(0.025)	(0.030)	(0.031)
NDI × PGS				-0.016	-0.024*	-0.031*
				(0.012)	(0.012)	(0.012)

Parental Education		0.119***	0.105***	0.105***	0.111***	0.110***
(PE, ref: *low*) *high*		(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
PE *high* × PGS					0.072**	0.067**
					(0.024)	(0.025)
School Quality (SQ, ref: *low*)		-0.012	-0.015	-0.017	-0.018	-0.017
medium		(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
high		0.052+	0.034	0.035	0.032	0.026
		(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
SQ (medium) × PGS						-0.003
						(0.030)
SQ (high) × PGS						0.053+
						(0.029)
Control Variables,						
Additive		X	X	X	X	X
Interactive				X	X	X
Constant	0.018	0.130*	0.110+	0.112+	0.104	0.107
	(0.012)	(0.066)	(0.066)	(0.066)	(0.066)	(0.066)
Observations	2,506	2,506	2,506	2,506	2,506	2,506
R-squared	0.018	0.075	0.089	0.091	0.094	0.095

Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Data: NCDS, Sweep 3. Not shown additive controls include household size, number of siblings and the first 10 principal components of genetic data; interactive controls include gender and urbanization.

Neighbourhood quality is significantly and positively associated with academic motivation across all models, although the effect size almost halves as I add linear and interactive control variables from Model 2 onwards. I observe a positive and significant association between the PGS and academic motivation, although this becomes non-significant after I include in the model the interaction between the PGS and parental education (Model 5) and between the PGS and school quality (Model 6). The main coefficient of interest is the interaction between the PGS and the neighbourhood index, which is negative and significant. In the final Model (Model 6), which includes all relevant covariates, I observe that living in a neighbourhood characterized by a one standard deviation increase in quality narrows the gap between individuals who are one standard deviation different in PGS by 0.031 units (when PGS=0, a one-standard deviation increase in neighbourhood quality increases academic motivation by 0.046 units, while when PGS=1, it increases academic motivation by only 0.015 units). Finally, as for cognitive skills, I find evidence for a positive moderating role of parental education on the effect of genes (0.067, p<0.01, Model 6). In contrast, I find only minor evidence of an interaction between the PGS and school quality (0.052, p<0.1, Model 6). Table C2 in the Appendix C displays results for all covariates.

I then test my expectation of a negative moderating effect of the neighbourhood on the link between genes and academic achievement. In Table 5.4, I find a strong and consistent positive effect of the neighbourhood index on academic achievement.

Table 5.4. R**egression models testing gene × neighbourhood interaction explaining academic achievement for the full sample in the UK**

Academic Achievement	(1)	(2)	(3)	(4)	(5)	(6)
Neighbourhood Deprivation Index (NDI)	0.684***	0.192***	0.196***	0.203***	0.200***	0.205***
	(0.052)	(0.058)	(0.056)	(0.056)	(0.056)	(0.055)
Polygenic score (PGS)			0.713***	0.825***	0.470***	0.320*
			(0.055)	(0.110)	(0.126)	(0.132)
NDI × PGS				-0.073	-0.132*	-0.222***
				(0.051)	(0.052)	(0.055)
Parental Education (PE, ref: *low*) *high*		0.813***	0.700***	0.704***	0.747***	0.738***
		(0.093)	(0.091)	(0.091)	(0.091)	(0.091)
PE *high* × PGS					0.537***	0.473***
					(0.095)	(0.094)
School Quality (SQ, ref: *low*)		0.511***	0.489***	0.486***	0.478***	0.499***
medium		(0.118)	(0.115)	(0.116)	(0.115)	(0.116)
high		1.649***	1.505***	1.511***	1.491***	1.442***
		(0.122)	(0.117)	(0.117)	(0.117)	(0.115)
SQ (medium) × PGS						0.203
						(0.126)
SQ (high) × PGS						0.594***
						(0.112)
Control Variables,						
Additive		X	X	X	X	X
Interactive				X	X	X
Constant	4.181***	4.404***	4.249***	4.243***	4.184***	4.216***
	(0.050)	(0.261)	(0.250)	(0.250)	(0.251)	(0.250)
Observations	2,506	2,506	2,506	2,506	2,506	2,506
R-squared	0.071	0.242	0.292	0.293	0.302	0.309

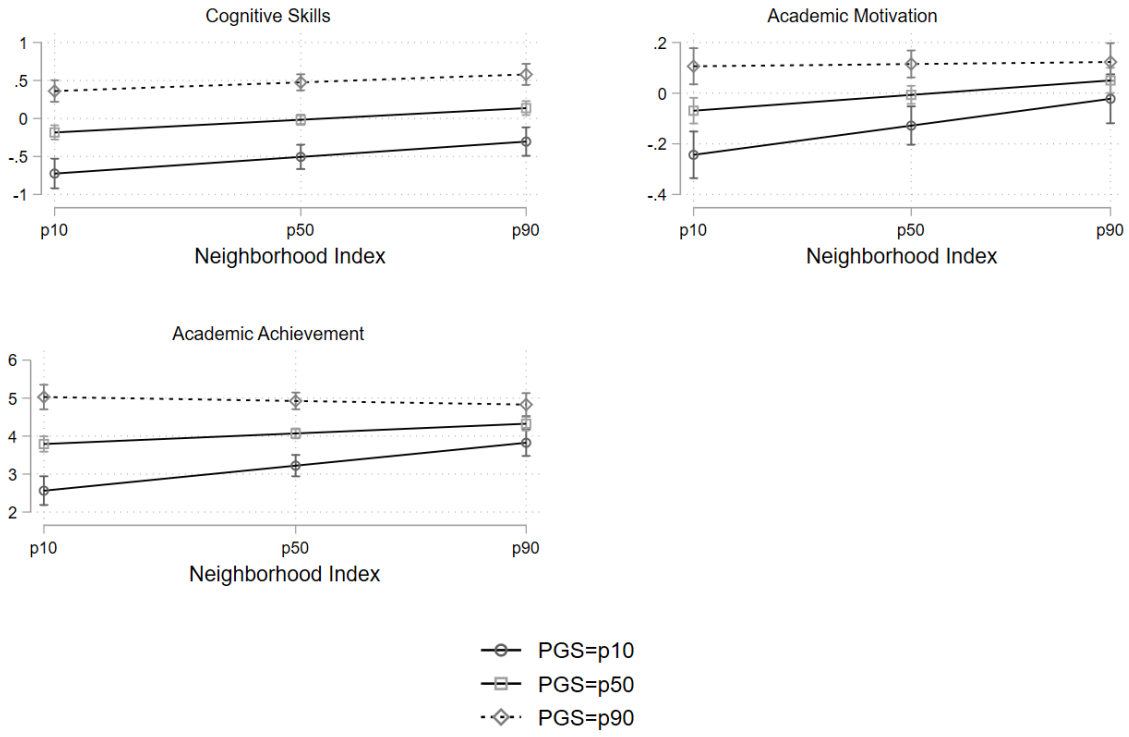
Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Data: NCDS, Sweep 3 and 4(academic achievement). Not shown additive controls include household size, number of siblings and the first 10 principal components of genetic data; interactive controls include gender and urbanization.

In the full model (Model 6), an increase by a one standard deviation on such index results in a 0.20 standard deviation increase in academic achievement for individuals with a mean PGS value (PGS=0) and adjusting for the other covariates. The association between the PGS and academic achievement is also positive and significant, and even stronger than the

neighbourhood one (p<0.05, Model 6). I next come to the interaction between the neighbourhood index and the PGS. As for academic motivation, the term becomes is negative and significant in Models 5 and 6. I observe that adding the interaction with parental education (Model 5) and school quality (Model 6) increases the coefficient, the significance level, but also the overall model R^2 (from 0.293 in Model 4 up to 0.309 in Model 6). The neighbourhood negatively moderates the effect of genes on education, as a one standard increase in neighbourhood quality narrows the gap between individuals who are one standard deviation different in PGS by 0.222 units (when PGS=0, a one-standard deviation increase in neighbourhood quality increases academic achievement by 0.205 units, while when PGS=1, it decreases academic motivation by 0.07 units). Finally, evidence for a Scarr-Rowe effect with regard to parental education (0.473, p<0.001) and high school quality (0.594, p<0.001) is also very strong and confirms findings from previous research. Table C3 in Appendix C showcases full results.

Figure 5.2 depicts the marginal predictions for the three outcomes of interest focusing on the 10th, 50th and 90th percentile of the NDI and the PGS respectively.

Figure 5.2. Marginal predictions for the outcomes of interest based on the 10th, 50th and 90th percentile of PGS and NDI for the full sample



Living in a higher or lower quality neighbourhood does not have any effect on the association between the PGS and cognitive skills, as individuals with higher PGS levels (p90) display

higher cognitive skills regardless of the residential area. However, for academic motivation and academic achievement, higher values of neighbourhood quality contribute to close the gap on the outcome between low and high PGS individuals. As the flat prediction shows, for individuals characterized by high PGS (p90), the socio-economic level of the neighbourhood does not seem to play a role. Lower levels of PGS (p10) are instead associated with greater cognitive skills at high levels of (p90) than at low levels (p10) of neighbourhood quality (that is higher socio-economic status).

I next focus on the social housing sample to evaluate whether my findings are robust to concerns related to neighbourhood selection. Table 5.5 summarizes results, for the social housing sample, concerning my main variable of interest, the interaction between the neighbourhood index and the PGS with respect to all three relevant outcomes. Tables C4-C6 in the Appendix C present full results.

Table 5.5. Regression models testing gene × neighbourhood interaction explaining cognitive ability, academic motivation and achievement for individuals in social housing in the UK.

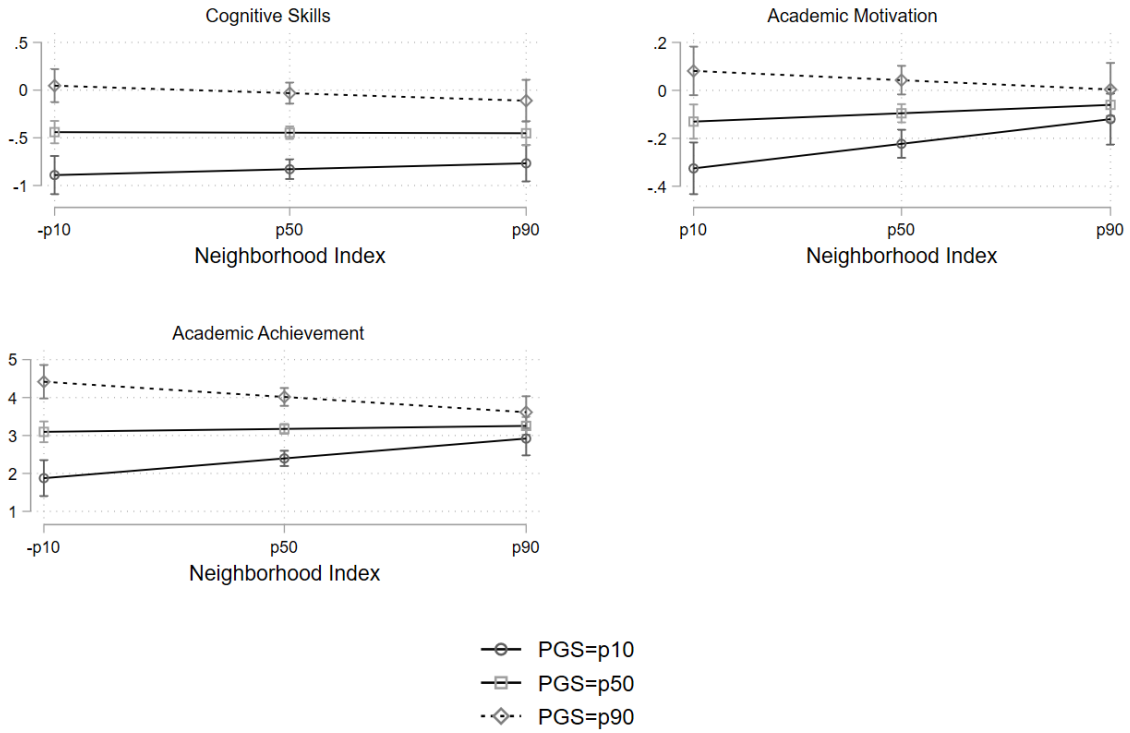
	Cognitive Ability	Academic Motivation	Academic Achievement
Neighbourhood Deprivation Index (NDI)	-0.004	0.043**	0.058
	(0.039)	(0.014)	(0.083)
Polygenic score (PGS)	0.261*	0.007	0.469+
	(0.115)	(0.032)	(0.244)
NDI × PGS	-0.041	-0.028*	-0.273**
	(0.039)	(0.013)	(0.097)
Control Variables,			
Additive	X	X	X
Interactive	X	X	X
Constant	0.148	0.143	4.343***
	(0.200)	(0.114)	(0.423)
Observations	1,016	1,016	1,016
R-squared	0.243	0.099	0.218

Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Data: NCDS, Sweep 3 and 4(academic achievement). Not shown additive controls include household size, number of siblings and the first 10 principal components of genetic data; interactive controls include gender and urbanization.

I observe that findings from this selected sample confirm predictions obtained in the full sample. I find indeed evidence for a non-significant, negative, interaction effect between PGS and neighbourhood on cognitive abilities (-0.041, $p>0.05$), and for a negative and significant association on academic motivation (-0.042, $p<0.05$) and academic achievement (-0.273,

p<0.01). Figure 5.3 depicts the marginal predictions for the three outcomes of interest. Again, for academic motivation and academic achievement, but not for cognitive skills, the PGS-related gap tend to narrow down at increasing levels of neighbourhood SES.

Figure 5.3. Marginal predictions for the outcomes of interest based on the 10th, 50th and 90th percentile of PGS and NDI for individuals in social housing in the UK



5.3.1. Robustness to working with genetic data

The literature has highlighted that various challenges apply when working with the results from genetic discovery studies. Population stratification may remain an issue in genetic discovery studies (Young et al., 2019) potentially biasing heterogeneity analyses on genetic effects across socio-economic groups (Mostafavi et al., 2019) and also region (Abdellaoui et al., 2018). In particular, associations between genetic background and social environments (i.e., gene-environment correlations, or rGE), based for example on the active or passive selection into different environments based on genetic background, can constitute a concern for research seeks to identify GxE interactions (Laidley et al., 2019). Assortative mating might also inflate genetic predictions (Young et al., 2019), as well as mechanisms of genetic nurture (Kong et al., 2017), according to which genetic variants linked to educational attainment which have not been transmitted from parents to children are predictive of their attainment, so that heritable parenting behaviour influences children education. One solution to solving these issues is to

base the PGS construction on GWAS studies conducted within, rather than between, families (Howe et al., 2021b). However, within family discoveries are still comparably small and result in weaker score predictions (Howe et al., 2021a) and very limited statistical power for investigations such as the one I present here. Furthermore, they might themselves introduce statistical issues related to deflated estimates (Trejo and Domingue, 2019). Thus, I opt for a different strategy. First, I control in my study – and so does the genetic discovery – for population stratification using principal components of the genetic data. This means controlling for genetic associations which are due to non-genetic effects, associated for example with different ancestry groups, such as religion, but also unobserved factors (Novembre et al., 2008). Second, by exploiting the social housing sample I can exclude residential sorting based on genetic predispositions and thus reduce concerns related to gene-environment correlations. Finally, I follow a previous study (Tropf et al., 2017) and simulate outcomes without gene-environment interaction based on genetic data and test for inflation of estimates due to population-based heterogeneity in the whole-genome regression framework. I find no evidence for such an inflation. In table C9 of appendix C, I provide additional details on this analysis.

5.4. Discussion and conclusion

In this chapter, I investigate the moderating effect of neighbourhood quality, measured by the Townsend Index, on the polygenic prediction for cognitive ability, academic motivation and achievement based on data from the 1958 British birth cohort.

I hypothesize that due to stronger protective mechanisms and collective efficacy in better neighbourhoods, genetic effects are compensated in contrast to low SES neighbourhoods. I find evidence supporting this hypothesis for academic motivation and achievement. However, I find no effect distinguishable from zero for cognitive abilities. Overall, findings find support for the fact that neighbourhoods as contextual dimensions operate quite differently in terms of genetic nurturing than families and schools. Explanations of Scarr-Rowe effects found in studies on the interplay between genetics and family and school SES mostly rely on the relative direct investments that parents and teachers tend to make in their own children. On the contrary, I posit here that the neighbourhood environments may operate more tacitly and indirectly, namely via the effect of social norms, cohesion and community stability, so overall by offering a more secure and pleasant environment for young adolescents to grow up in. Such a view aligns with the existing literature, according to which high-poverty neighbourhoods affect educational outcomes via their lack of opportunities, which lead to aberrant values and norms,

a weakening of social institutions, and limited access to neighbours who can act as positive role models and provide tangible resources for support (McBride Murry et al., 2011). Individuals characterized by a high polygenic score might be more resilient, and thus not suffer any consequences of being embedded in such contextual challenges. On the contrary, individuals characterized by low polygenic score might not be as capable, thus remaining "left behind" in the context of poorer areas.

As in the previous Chapter 3, I find similar effects for both the main sample and a subsample of individuals living in social housing which provides me with confidence about the fact that results are not merely driven by processes of neighbourhood selection.

Conclusion

In this dissertation, I have aimed to provide a comprehensive assessment of neighbourhood effects on cognitive and non-cognitive dimensions of youth development and a detailed description of its heterogeneous impacts. To do so, I have relied on a large, longitudinal and rich British dataset, the NCDS, which provides relevant information concerning individual skills, their family and residential history, as well as their genetic endowment.

Chapter 1 provided the theoretical grounding for the study of neighbourhood effects on education-related, developmental outcomes. I built on an existing framework (Levy, 2019, 2021) to explore how gender, past trajectories of neighbourhood disadvantage, and education-related genes may account for heterogeneous neighbourhood effects.

Chapter 2 framed this work within the broader UK context, presented in detail the information available from the NCDS data, and, later, it focused on the empirical strategies used within neighbourhood research.

The analysis of neighbourhood effects on youth outcomes was the main topic of the three empirical chapters.

Chapter 3 aimed to re-assess gender-related neighbourhood effect heterogeneity on a variety of cognitive and non-cognitive outcomes. This was done by focusing specifically on the interaction between neighbourhood deprivation and gender. In alignment with previous literature, I found that living in more deprived areas has an overall negative effect on cognitive and non-cognitive dimensions of development. However, neighbourhood deprivation affects more negatively girls', as compared to boys', cognitive skills, academic motivation and employability skills, while no significant gender difference is detected for problem behaviour. To make sense of such findings, I discussed potential relevant mechanisms and, in particular, the role of support and gender stereotypes, which tend to be respectively scarcer and greater in more deprived contexts, thus affecting females' own educational aspirations and, by consequence, their overall cognitive and non-cognitive development.

In Chapter 4, I expanded on the multigenerational line of inquiry within neighbourhood research and I estimated how neighbourhood environments experienced across two generations, as well as their combination into different trajectories of exposure to neighbourhood disadvantage, affect youth cognitive skills and socio-emotional behaviour. Previous related works in the US (Sharkey and Elwert, 2010, 2011) found evidence for the fact that exposure to neighbourhood poverty during two successive generations negatively affects children's

cognitive skills and educational expectations and aspirations, but not health outcomes. In the UK context, I found evidence for a similar and markedly negative effect of experiencing neighbourhood deprivation across generations not only on cognitive skills, but also on youth socio-emotional behaviour. In particular, youth with longstanding trajectories of living in deprived neighbourhood contexts are the most affected, as compared with youth with more varied spatial mobility paths, when it comes to exhibiting negative developmental outcomes.

Finally, in Chapter 5, I adopted a cross-disciplinary approach, combining insights from sociology and behavioural genetics to assess the moderating role of neighbourhood advantage over the effect of education-related genes on three education-related outcomes. I found evidence for a compensatory role of good quality neighbourhood characteristics. In fact, living in higher socio-economic status neighbourhoods contributes to closing the gap between individuals characterised by high and low genetic predispositions towards academic motivation and academic achievement, while it has a null effect on cognitive skills.

Theoretical Implications

The theoretical starting point of this thesis was that neighbourhoods exert heterogeneous effects on different individuals. Across all three empirical chapters, the need to focus on heterogeneity emerges as justified. Neighbourhood deprivation, indeed, differently affects youth, along the lines of their gender, their family history of neighbourhood disadvantage, as well as their genetic endowment, overall leading to a multiplicity of life outcomes and trajectories.

Focusing on the heterogeneity of neighbourhood effects can contribute to better pinpoint and understand the mechanisms behind neighbourhood influence. As stressed by Small and Feldman (2012), it is still unclear which neighbourhood pathways of influence might be theoretically relevant under different circumstances. In this dissertation, the social aspects of the neighbourhood environment seem to emerge as key dimensions concerning how they may influence youth cognitive and non-cognitive development. Namely, Chapter 3 highlights the "socio-cultural" dimension of the neighbourhood as a critical pathway influencing neighbourhood's youth behaviour with their attitudes and beliefs. In Chapter 5, I similarly note that neighbourhoods can exert their influence differently from families, by operating more tacitly and indirectly, namely via the effect of social norms, cohesion and community stability, rather than by means of direct investments. Chapter 4 unveils and proposes, although not formally testing, different mechanisms through which past neighbourhood environments might remain relevant and their effects persist across generations. They do all somehow relate, again,

to the socio-cultural reproduction of values, attitudes and behaviours that may take place via the transmission of context or due to the legacy of educational, occupational and health inequalities.

My findings also led me to re-think the differential role that neighbourhoods might play when influencing two different sets of skills, cognitive and non-cognitive ones. My results seem coherent with the argument put forward by other scholars that neighbourhoods are particularly important for non-cognitive outcomes (Gibbons et al., 2013; List et al., 2020), whereas families and schools might be more relevant for the development of cognitive skills. One reason might lie in the fact that non-cognitive skills are perhaps less responsive to parental resources and investments than cognitive ones, and more responsive instead to patterns of social interaction dynamics ingrained within the local area. This has important theoretical consequences, since the non-cognitive outcomes have, so far, been under-researched in the neighbourhood field (except for problem behaviour) in comparison to cognitive and educational ones.

Under this view, an interesting divergence I found throughout my analysis is the fact that, while I found evidence for an effect of contemporary neighbourhood deprivation on cognitive skills in youth 1974 (Chapter 3 and Chapter 5), I fail to find such effect later on youth in 1991 (Chapter 4). Why can it be that neighbourhoods "lose", or seem to lose, their ability to influence such skills over time? Of course, a naive response could be that samples used to carry out the three empirical analyses are different. However, an alternative response point to a critical role of the broader socio-political context, and how this may intersect and somehow change the way in which neighbourhoods may operate. In the UK across time, neighbourhoods have become increasingly less mixed and diverse. The implementation of policies aimed at increasing homeownership throughout the 1980s in the UK resulted in both greater social class spatial segregation and greater correlation between neighbourhood and family characteristics in the 1990s than in the 1970s. Across these years two opposite processes took place at the same time. On the one hand, there was a dispersion of better-off home owners across neighbourhoods characterised by different deprivation levels; on the other hand, segregation of poorer home owners in the bottom neighbourhood deprivation quartile, particularly for people in manual occupations, largely increased (Lyons, 2003). Hence, it could be that progressive increase in similarity between family and neighbourhood characteristics might have weakened the role of the neighbourhood environment. In other words, part of the neighbourhood effect might have been taken up by other family and household characteristics over time.

Finally, in this thesis I also theoretically reflect on the role played by the neighbourhood in exacerbating social inequality over time. An important merit of the framework put forward

by Levy (2019, 2021) is indeed to clarify that neighbourhoods plays a complex role in moderating other drivers of inequality. Both the cumulative advantage and disadvantage theories predict widening inequality gaps over time. In contrast, the advantage leveling hypothesis and compensatory hypothesis imply an overall reduction in the inequality gaps, although in different directions (as the advantage leveling hypothesis posits a reduction of pre-existing advantages, whereas the compensatory model assumes a compensation of pre-existing disadvantage). Across the empirical analyses, two of the aforementioned theories hold. In Chapters 3 and 4, exposure to neighbourhood disadvantage enlarges pre-existing inequalities gaps. In the former, because of gender gap, due to the lack of female-supportive elements within neighbourhoods, and, in the latter, because of the multigenerational gap in previous experiences of deprivation driven by past and accumulated forms of disadvantage. At the same time, in Chapter 5, I showed that positive neighbourhood environments compensate for pre-existing inequalities. This last result gives hope by highlighting how living in good and high quality neighbourhood environments can help to interrupt the cycle of disadvantage that often characterise individuals living in more disadvantaged contexts. Under this view, it seems therefore increasingly important to move the theoretical debate from exploring the consequences of neighbourhood disadvantage to exploring the means through which neighbourhood *advantage* may ameliorate individuals' own histories and experiences. Framing the neighbourhood discourse under this light provides some new food for thought, since it highlights that policy responses focused on disadvantaged urban areas and communities can have a significant impact in contributing to improving levels of education and overall may work as a pathway to reduce social inequalities.

Policy Implications

Findings from all three chapters have relevant policy implications, especially if one considers the recent "Levelling Up" agenda set for the UK. We have seen that places, and neighbourhoods, matter to people. But to what extent has the governmental agenda recognised this? In a critical analysis, Overman (2022) argues that the proposed policy plan is still very much skewed towards narrowing gaps between regions in the country, rather than gauging the policy's effect on the different people living in different places. Much of the focus (4 of the government's missions out of 12 in total) seem concentrated on reducing regional differences in terms of productivity and economic opportunities. The result is that a narrower focus and, consequently, lower investments, have been dedicated to the multiple barriers that characterise

genuinely "left behind" places, all of which relate not only to education and skills, but also to childcare, mental and physical health services (Overman, 2022). In addition to that, such approach shows that policy, with their focus on regional differences, seems to be ignoring the importance of smaller scale geographies like neighbourhoods. However, it is typically at such local level that positive interactions and exchanges between individuals are more likely to take place, and at which communities can thus feel genuinely empowered.

Evidence from this thesis highlights the importance of investing not only into increasing the structural and economic opportunities available in the most disadvantaged areas, but also in that form of infrastructure that contributes to positively changing the values and beliefs ruling in the poorest neighbourhoods. Under this view, it is important, for a comprehensive "Levelling Up" policy, to aim at structural investments, for example public infrastructure, but also in promoting intangible values. This supports the implementation of policies that aim at increasing social cohesion and collective efficacy, which in turn might contribute to enhance the "protective" role of the neighbourhood environment. Similarly, my results endorse housing policies that encourage greater housing and social mixing, that have also been associated with greater social cohesion (Van Kempen and Bolt, 2009).

This is of uttermost importance especially for the most socially and financially disadvantaged individuals, who often risk remaining "locked in" within their cluster of disadvantage (Dannefer, 2003). When it comes to skill development, for disadvantaged youth the neighbourhood dimension may be even more relevant than the family one (Patacchini and Zenou, 2011). In fact, lower-income parents experience multiple barriers, both socio-economic and psychological, that prevent them from being involved with their children education (Lechuga-Pena et al., 2019). Under such conditions, adolescents are forced to rely heavily on resident adults and neighbourhood institutions (Wodtke et al., 2016). The aforementioned policies may thus contribute to reduce the local clustering of disadvantage, thus positively affecting disadvantaged people born into poorer families.

Coming back to Wilson (1987)'s social isolation argument, I contend here that "Levelling Up" thus needs to be about modifying and improving the normative culture ruling within "left behind" spaces. What does that mean in practice? In a 2021 poll (Local Trust, 2021) carried out in 225 neighbourhoods in England falling into the 10% most deprived regions, individuals cited "community facilities" as the most critical area (66%) in which they believed were not getting their fair share of the nationwide resources, compared to nearby communities. This was closely followed by community projects such as leisure and sports facilities (58%) and places to meet more generally (50%). Interestingly, investment in job opportunities and

tackling unemployment was only in third place (53%). Again, all of this seems to provide additional support for the fact that it is the social and civic infrastructure of neighbourhoods that might also matter and that has so far been ignored, thus, for the need to balance the creation of new economic opportunities with investment in the local social infrastructure.

From the literature on class mobility, we know that promoting social mobility, i.e. providing individuals with greater opportunities to move up or down the class ladder rather than being restricted by their social background, contributes to a more equal distribution of resources and opportunities, thus reducing overall inequalities. In parallel, my findings emphasise the need to not only incentivise neighbourhood mobility but also to target and address the root causes of neighbourhood deprivation adopting pragmatic responses. By uplifting deprived neighbourhoods consistently over time, individuals and families residing in these areas are given better chances for upward mobility and improved quality of life. Ultimately, reducing neighbourhood deprivation thus contributes to the reduction of inequalities across generations by ensuring that all members of society have equal access to the resources and opportunities necessary to thrive, irrespective of their geographic location.

Limitations and avenues for future research

Provided its contribution to the literature about the heterogeneity of neighbourhood effects, this dissertation has several limitations, that could also provide avenues for additional research, overall contributing to a future research agenda on neighbourhood effects.

First, more work should be dedicated to the effort of testing existing theorised mechanisms, as well as hypothesising new mechanisms, concerning the role of the neighbourhood on youth development. Under this view, one important aspect is to take into account multiple neighbourhood characteristics at the same time. Although the Townsend index used within this dissertation provides indeed a comprehensive and multidimensional measure of area deprivation, it does not cover a variety of other intangible features characterising one's own neighbourhood environment, and that I highlighted as critical mechanisms. Namely, peer dynamics, gender attitudes, one's own perception of the neighbourhood and neighbourliness cannot be directly tested here due to data constraints. Although these are tightly interconnected with each other and with measures of deprivation, assessing the role of each of them specifically will be required to provide additional insights with regard to the specific mechanisms through which neighbourhoods might exert their heterogeneous effect. In addition to that, many of these mechanisms seem be composed of an intangible, value-based, component and thus can appear

to be almost hidden (that is, just embedded in the natural social interaction taking place at the neighbourhood level). Thus, the integration of qualitative methods might be the best tool to try to unveil the genuine features of such pathways of influence.

Second, notwithstanding the difficulties related to producing sociological research at the intersection of different disciplines, this is an important and potentially rich area in which to carry out further research. This work has specifically aimed at integrating insights from sociology and behaviour genetics. In this context, this study has provided important advances, identifying both genetic and environmental (neighbourhood) predictors statistically. Nonetheless, theoretically, we are still working with aggregate measures on both the genetic and the neighbourhood side. The PGS-approach indeed represents an aggregate of various potential mechanisms linking the genome to educational outcomes. At the same time, as previously mentioned, the neighbourhoods operate via several and highly complex mechanisms. In addition to that, so far we still need to rely, in most cases, on quasi-monocausal empirical expectations for observed patterns of moderation of genetic links to social science outcomes such as the Scarr-Rowe and the compensatory advantage model. However, gene-environment interactions are a multi-dimensional and multi-level phenomenon (Mills et al., 2020; Mills and Tropf 2020)- Hence, more thorough theorising will be needed on this matter.

Third, I call for a more thorough integration of a multigenerational approach within neighbourhood research. In chapter 4, I touched upon this particular topic, stressing the longstanding impact that neighbourhoods might have and highlighting how discarding family trajectories of neighbourhood disadvantage could result in downplaying the real effect of neighbourhoods on inequality dynamics. Nonetheless, this chapter presents some relevant limitations. One of the main ones is that I only have access to the adolescence residential neighbourhood for one of the two parents. This means that the picture of all grandparents and parental background, concerning their neighbourhood experiences, is partially incomplete. Theoretically, how relevant this constraint is to my findings is uncertain. If mating is assortative, then one parent's background can act as a proxy for the other's, in which case my findings are not likely to be affected. Evidence from the 1958 and 1970 cohorts seems to point in this direction, further suggesting that assortative mating has increased in Britain across these two cohorts (Blanden, 2005). Nonetheless, in those families where individuals come from very different backgrounds, partners are likely to influence each other in their differential directions, with ambiguous net results. Hence, this remains a subject for future research. Furthermore, although I find clear evidence for a multigenerational neighbourhood effect, I am not here disentangling the specific mechanisms through which neighbourhood effects might exert and

pass on their influence intergenerationally and cumulatively. In order to do so, formal mediation analyses should be carried out exploring which elements, which are themselves influenced by past neighbourhood environments, such as future residential characteristics, education or social class, are mostly responsible for the continuity of the reproduction of inequalities over time.

Finally, additional in-depth work should be carried out to continue investigating the heterogeneity, and the intersectionality, of neighbourhood effects. The findings of this thesis reinforce the idea that focusing on an *average* neighbourhood effect on youth development is a simplification of the real-life patterns. I believe that further exploration should be granted at the intersection between neighbourhood and other forms of advantage or disadvantage, following Levy (2019, 2021) and what has been done within this thesis. It is important to note that the data leveraged in this analysis refer to a period spanning from the 1970s to the 1990s, surely characterised by different socio-economic conditions and cultural features than the current one. The objective of this dissertation was to start exploring the heterogeneity of neighbourhood effects in the UK, according to different dimensions. On the one hand, this is important because such heterogeneous effects are likely to have had a long-lasting impact. For example, as the individuals who were adolescents in the 1970s grew older, entered the labour market and had increasing opportunities to shape societal rules, early on skill gaps could still be relevant when it comes to the structure, and the reproduction, of inequalities nowadays. On the other hand, it seems important to further understand how neighbourhood effects might be socially embedded within the broader societal context, considering that this may overall affect also the way in which individuals live and are themselves influenced by their neighbourhood environment. Further research could thus build along these lines in order to understand if and how the same patterns and mechanisms found within this work are still in place or how they differ, exploiting for example more recent data in the UK, from the British Cohort Study (1970s cohort) to the Millennium Cohort Study (2000s cohort).

Appendix

Appendix A

Operationalisation of the outcomes

Table A1. PCA to Derive Cognitive Ability Measure

PCA				
Eigenvalue	Loading		% Variance	N
	Reading	Math		
1.65	0.70	0.70	82%	11,919

Table A2. Confirmatory Factor Analysis results to Derive Academic Motivation Measure

Construct	Item	Loading	Cronbach's alpha	Average Variance Extracted	Construct Reliability
Academic Motivation	School waste of time	0.724***	0.79	0.36	0.81
	Get on with classwork	0.483***			
	Homework is a bore	0.678***			
	Difficult keep mind on work	0.604***			
	Take work seriously	0.733***			
	Don't like school	0.782***			
	No point planning for future	0.341***			
	Always ready to help teacher	0.321***			

Notes: For each question, responses span from 1 to 5, where 1 is "very true", 2 is "usually true", 3 is "cannot say", 4 is "usually untrue", 5 stands for "not true at all" and some items are reverse-coded so that they are all in the same, positive, direction (i.e. for "I get on with classwork"). Significance level: *** - p<=0.01. Fit statistics: χ^2= 2024,02(df=20, p=0.00) ; RMSEA= 0.093; CFI=0.94 ; SRMR= 0.052 ; GFI=0.99)

Table A3. Factor Analysis to Derive Employability Skills Measure

First-Order Construct			Second-order
	Item	Loading	Loading
Teacher-reported information (α=0.73; AVE=0.51)	Hardworking-Lazy*	0.799***	0.77
	Cautious-Impulsive*	0.377***	
	Sociable-Withdrawn*	-0.301***	
	Flexible-Rigid*	-0.421***	
	Responsive	0.753***	
	Obedient	0.892***	
	Accept corrections	0.815***	
	Play truant	0.906***	
	No school absences for trivial reasons	0.853***	
Self-reported information (α =0.72; AVE=0.38)	School waste of time	0.705***	0.851
	Homework is a bore	0.596***	
	Take work seriously	0.714***	
	No point planning for future	0.381***	
	Truancy this year	0.628***	

Notes: Items are coded so that higher scores indicated better employability skills. Self-reported responses are based on a 1-5 Likert Scale (see Academic Motivation); for teacher-reported information, behaviour ranks (marked with*) are based on a five point spectrum, while other responses vary from 1 to 3, based on "does not apply/applies somewhat/certainly applies". Significance level: *** - p<=0.01. Composite Reliability (CR) = 0.811; Reliability second-order factor Ω=0.83. Fit statistics: χ^2= 9630,399 (df=76, p=0.00) ; RMSEA= 0.108; CFI=0.894 ; SRMR= 0.089 ; GFI=0.975)

Table A4. Results from Exploratory and Confirmatory Factor Analysis to derive Lack of Internalising and Externalising Behaviour Measures

	Confirmatory Factor Analysis		Exploratory Factor Analysis			
Item	First-order Factor loading	Second-order Factor loadings	Lack of Internalising Problems	Lack of Externalising Problems	Eigenvalues	% Variance Explained
Lack of Internalising Problems (α=0.97, AVE=0.69)					4.75	18%
Worries about many things	0.53***	0.61	0.83			
Tends to be on own, solitary	0.59***		0.62			
Appears miserable, unhappy	0.919***		0.65			
Twitches, mannerisms	0.738***		0.53			
Frequently sucks thumb or finder	0.595***		0.44			
Fearful	0.661***		0.74			
Fussy, over particular	0.393***		0.56			
Often complains of aches	0.756***		0.54			
Tears on arrival at school, refusal to enter	0.827***		0.63			
Has a stutter or stammer	0.484***		0.47			
Frequently bites nails	0.578***		0.35			
Lack on Externalising Problems (α=0.96, AVE=0.43)					10	38%
Restless, difficulty staying seated	0.861***			0.76		
Past year truanting	0.861***			0.71		
Squirmy, fidgety	0.85***			0.7		

Destroys, damages things	0.851***	0.99		0.92		
Frequently fights, quarrelsome	0.883***			0.89		
Irritable, touchy	0.832***			0.74		
School absences for trivial reasons	0.81***			0.56		
Often disobedient	0.902***			0.98		
Cannot settle	0.84***			0.77		
Often tell lied	0.891***			0.88		
Has stolen at least once in past yrs	0.754***			0.76		
Unresponsive, inert	0.679***			0.54		
Resentful, aggressive when corrected	0.869***			0.87		
Bullies other children	0.867***			0.92		
Not much liked by other children	0.734***			0.51		

Notes: Significance level: *** - p<=0.01. EFA: items were considered to load on a factor when loading>0.3. CFA Composite Reliability (CR) = 0.811. CFA fit statistics: χ^2= 16844,87 (df=298, p=0.00) ; RMSEA= 0.069; CFI=0.926 ; SRMR= 0.102 ; GFI=0.979)

Table A5. Overview of dependent variables operationalisation

Variable	Measures
Cognitive Skills	First of two factors from a principal component factor analysis (rotated). Variability explained by the first component equal to 82%.
Academic Motivation	Factor score deriving from a confirmatory factor analysis over eight self-reported items related to attitudes towards school. Acceptable to Good model fit (CFI>0.9, RMSEA<0.1; GFI>0.95; SRMR< 0.08)
Employability Skills	Factor score deriving from a second-order confirmatory factor analysis leveraging respectively self-reported and teacher-reported information. Acceptable model fit (CFI=0.89; RMSEA=0.1; GFI>0.95; SRMR=0.08)
Lack of Internalising and Externalising Behaviour	Factor scores deriving from an exploratory analysis (loading coefficients >.3) and a second-order confirmatory factor analysis. Good model fit (CFI>0.9; RMSEA<0.08 , GFI>0.95; SRMR>0.8)

Notes: The evaluation of model fit is proposed according to classic rules of thumb comparing the values of different indexes of fit (Hu & Bentler, 1999).

Table A6. Bivariate correlation of the five outcome

Variables	Cognitive Skills	Academic Motivation	Employability Skills	Lack of Internalising Behaviour	Lack of Externalising Behaviour
Cognitive Skills	1.000				
Academic Motivation	0.302***	1.000			
Employability Skills	0.428***	0.810***	1.000		
Lack of Internalising Behaviour	0.336***	0.247***	0.477***	1.000	
Lack of Externalising Behaviour	0.404***	0.416***	0.731***	0.730***	1.000

Notes: *** p<0.01, ** p<0.05, * p<0.1

Table A7. Summary, full model, full sample

VARIABLES	(1) Cognitive Skills	(2) Academic Motivation	(3) Employability Skills	(4) Lack of Internalising Behaviour	(5) Lack of Externalising Behaviour
Nhb deprivation(std)	-0.112***	0.009	-0.018+	-0.027**	-0.051***
	(0.025)	(0.014)	(0.009)	(0.009)	(0.014)
Gender/Ref: Male					
Female	-0.170***	0.081***	0.070***	0.008	0.115***
	(0.030)	(0.017)	(0.011)	(0.011)	(0.016)
Female*Nhb	-0.083**	-0.062***	-0.030**	-0.014	-0.021
	(0.030)	(0.016)	(0.011)	(0.010)	(0.016)
Ethnicity/Ref: White					
Non-White	-0.499***	0.176**	0.038	-0.023	-0.087
	(0.117)	(0.065)	(0.045)	(0.041)	(0.064)
Area/Ref: Rural					
Urban	0.112**	0.030	0.023+	-0.011	0.015
	(0.036)	(0.020)	(0.014)	(0.013)	(0.020)
School Meals/Ref: Does not receive					
Receives free school meals	-0.366***	-0.025	-0.049*	-0.096***	-0.098**
	(0.063)	(0.035)	(0.024)	(0.022)	(0.035)
Sch meals:Other or don't know'	-0.199	0.282	-0.024	0.041	-0.040
	(0.369)	(0.205)	(0.141)	(0.130)	(0.203)
Social Class/Ref:I					
Social Class : II	-0.126	-0.044	-0.022	-0.050+	-0.043
	(0.078)	(0.043)	(0.030)	(0.027)	(0.043)
Social Class : III non manual	-0.267**	-0.045	-0.054	-0.064*	-0.051
	(0.087)	(0.048)	(0.033)	(0.031)	(0.048)
Social Class : III manual	-0.467***	-0.122**	-0.104***	-0.095***	-0.099*
	(0.077)	(0.043)	(0.030)	(0.027)	(0.042)
Social Class : IV	-0.603***	-0.108*	-0.099**	-0.095**	-0.088+
	(0.084)	(0.047)	(0.032)	(0.030)	(0.046)
Social Class : V	-0.773***	-0.106+	-0.128**	-0.124***	-0.182**
	(0.105)	(0.058)	(0.040)	(0.037)	(0.058)
Household Size /Ref: 3					
Household Size : 1/2	0.014	0.115	0.068	-0.056	0.063
	(0.133)	(0.074)	(0.051)	(0.047)	(0.073)
Household Size : 4	-0.055	0.016	0.039*	0.010	0.060*
	(0.050)	(0.028)	(0.019)	(0.018)	(0.027)

Household Size : 5	-0.134*	0.017	0.010	0.012	0.040
	(0.053)	(0.030)	(0.020)	(0.019)	(0.029)
Household Size : 6+	-0.214***	0.025	0.007	-0.024	-0.002
	(0.058)	(0.032)	(0.022)	(0.020)	(0.032)
Siblings/Ref: No Siblings					
1 to 3 siblings	-0.081	-0.133***	-0.063*	0.003	-0.043
	(0.066)	(0.037)	(0.025)	(0.023)	(0.036)
4+ siblings	-0.272***	-0.187***	-0.134***	-0.036	-0.151***
	(0.079)	(0.044)	(0.030)	(0.028)	(0.043)
Parental Education/Ref: Low					
Parents: Medium Educ	0.211***	0.028	0.027*	0.005	0.014
	(0.033)	(0.018)	(0.013)	(0.012)	(0.018)
Parents: High Educ	0.594***	0.065+	0.063**	0.034	0.031
	(0.060)	(0.033)	(0.023)	(0.021)	(0.033)
Parental Interest/Ref: Parents not much interested					
At least one parent interested	0.563***	0.321***	0.308***	0.080***	0.273***
	(0.033)	(0.018)	(0.013)	(0.012)	(0.018)
Own Room/Ref: Does not have					
Has own room	0.271***	0.170***	0.111***	0.056**	0.132***
	(0.048)	(0.027)	(0.019)	(0.017)	(0.027)
Constant	0.210+	-0.090	-0.086+	0.017	-0.162*
	(0.123)	(0.068)	(0.047)	(0.044)	(0.068)
Observations	4,906	4,906	4,906	4,906	4,906
R-squared	0.284	0.131	0.226	0.078	0.145

Notes: Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Regional fixed effects included.

Table A8. Summary, full model, social housing sample

VARIABLES	(1) Cognitive Skills	(2) Academic Motivation	(3) Employability Skills	(4) Lack of Internalising Behaviour	(5) Lack of Externalising Behaviour
Nhb deprivation(std)	-0.083*	0.017	-0.016	-0.044**	-0.061**
	(0.039)	(0.022)	(0.015)	(0.015)	(0.023)
Gender/Ref: Male					
Female	**-0.307*** **	**0.018**	**0.032**$^{+}$	**-0.022**	**0.094*** **
	(0.047)	**(0.026)**	**(0.018)**	**(0.017)**	**(0.028)**
Female*Nhb	**-0.094***	**-0.073****	**-0.041***	**-0.007**	**-0.038**
	(0.047)	**(0.026)**	**(0.018)**	**(0.017)**	**(0.027)**
Ethnicity/Ref: White					
Non-White	-0.026	0.126	0.056	0.052	-0.02
	(0.235)	(0.132)	(0.092)	(0.088)	(0.138
Area/Ref: Rural					
Urban	0.137*	0.002	0.017	0.017	0.062
	(0.065)	(0.036)	(0.025)	(0.024)	(0.038)
School Meals/Ref: Does not receive					
Receives free school meals	-0.213**	-0.004	-0.020	-0.078**	-0.068
	(0.078)	(0.044)	(0.030)	(0.029)	(0.046)
Sch meals:Other or don't know'	-0.292	0.396	0.098	0.112	0.130
	(0.532)	(0.299)	(0.207)	(0.198)	(0.313)
Social Class/Ref:I					
Social Class : II	-0.535^{+}	-0.171	-0.279*	-0.140	-0.424*
	(0.325)	(0.183)	(0.127)	(0.121)	(0.191)
Social Class : III non manual	-0.791*	-0.234	-0.353**	-0.155	-0.429*
	(0.327)	(0.183)	(0.127)	(0.122)	(0.192)
Social Class : III manual	-0.903**	-0.221	-0.329**	-0.167	-0.424*
	(0.314)	(0.176)	(0.122)	(0.117)	(0.185)
Social Class : IV	-1.007**	-0.194	-0.322**	-0.172	-0.411*
	(0.317)	(0.178)	(0.124)	(0.118)	(0.186)
Social Class : V	-1.119***	-0.247	-0.343**	-0.176	-0.438*
	(0.326)	(0.183)	(0.127)	(0.121)	(0.192)
Household Size /Ref: 3					
Household Size : 1/2	-0.117	0.267*	0.122	-0.099	0.133
	(0.187)	(0.105)	(0.073)	(0.070)	(0.110)
Household Size : 4	-0.147^{+}	0.022	0.037	-0.006	0.047
	(0.081)	(0.046)	(0.032)	(0.030)	(0.048)
Household Size : 5	-0.206*	0.020	0.007	-0.009	0.033

	(0.084)	(0.047)	(0.033)	(0.031)	(0.050)
Household Size : 6+	-0.308***	0.076	0.025	-0.030	0.004
	(0.089)	(0.050)	(0.035)	(0.033)	(0.052)
Siblings/Ref: No Siblings					
1 to 3 siblings	-0.136	-0.234***	-0.111*	0.044	-0.027
	(0.113)	(0.063)	(0.044)	(0.042)	(0.066)
4+ siblings	-0.356**	-0.310***	-0.201***	0.002	-0.157*
	(0.127)	(0.071)	(0.050)	(0.047)	(0.075)
Parental Education/Ref: Low					
Parents: Medium Educ	0.133**	-0.005	0.004	-0.010	-0.022
	(0.049)	(0.028)	(0.019)	(0.018)	(0.029)
Parents: High Educ	0.447*	0.088	0.139	-0.006	0.108
	(0.221)	(0.124)	(0.086)	(0.082)	(0.130)
Parental Interest/Ref: Parents not much interested					
At least one parent interested	0.615***	0.385***	0.362***	0.124***	0.380***
	(0.055)	(0.031)	(0.022)	(0.021)	(0.033)
Own Room/Ref: Does not have					
Has own room	0.228**	0.184***	0.104***	0.030	0.105*
	(0.070)	(0.039)	(0.027)	(0.026)	(0.041)
Constant	0.785*	0.158	0.214	0.053	0.124
	(0.353)	(0.198)	(0.138)	(0.131)	(0.208)
Observations	1,958	1,958	1,958	1,958	1,958
R-squared	0.213	0.127	0.199	0.073	0.137

Notes: Standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Regional fixed effects included.

Appendix B

Table B1. Trajectories of multigenerational effects. Two most deprived vs. Three less deprived neighbourhood quintiles

VARIABLES	(1) Cognitive skills	(2) Socio-emotional Behaviour
Trajectory/Ref: Stable Deprived		
Downward	0.081	0.092
	(0.070)	(0.077)
Upward	0.088	0.064
	(0.056)	(0.062)
Stable Non-Deprived	0.128*	0.159**
	(0.064)	(0.061)
Child Age	0.023***	0.019***
	(0.005)	(0.005)
Child Sex/Ref: Male		
Female	0.083*	-0.006
	(0.037)	(0.040)
Parent Gen, Sex/Ref: Male		
Female	-0.039	0.118**
	(0.040)	(0.038)
Parent Gen, Mother age at birth	-0.004	-0.008+
	(0.003)	(0.004)
Parent Gen, Tenure/Ref: Not Owned		
Own	-0.074	0.003
	(0.051)	(0.058)
Parent Gen, Household Size	-0.017	0.011
	(0.013)	(0.014)
Parent Gen, Parental Educ/Ref: Low		
Medium	0.086+	0.003
	(0.050)	(0.049)
High	0.082	-0.130
	(0.090)	(0.099)
Parent Gen, Income	-0.019	0.001
	(0.033)	(0.039)
Parent Gen,Region/Ref: England and Wales		
Scotland	0.056	0.131
	(0.126)	(0.128)
Parent Gen,Urban/Ref: Rural		
Urban	0.089+	-0.013
	(0.050)	(0.049)
Child Gen, Tenure/Ref: Not Owned		
Own	0.058	0.054
	(0.054)	(0.054)
Child Gen, Household Size	-0.050*	-0.008
	(0.022)	(0.021)

Child Gen, Parental Educ/Ref: Low		
Medium	0.110	0.302***
	(0.073)	(0.086)
High	0.184*	0.397***
	(0.092)	(0.100)
Child Gen, Income	-0.025	0.022
	(0.023)	(0.024)
Child Gen,Region/Ref: England and Wales		
Scotland	0.024	0.046
	(0.122)	(0.128)
Child Gen,Urban/Ref: Rural		
Urban	-0.057	-0.083
	(0.047)	(0.053)
Parental Cognitive Skills	0.131***	0.045*
	(0.022)	(0.021)
Parental Marital Status/Ref: Without Partner		
With Partner	0.004	0.153
	(0.078)	(0.098)
Parental Health/Ref: Poor		
Fair	0.172	0.399*
	(0.159)	(0.199)
Good	0.079	0.510*
	(0.150)	(0.200)
Constant	-0.089	-1.307***
	(0.240)	(0.297)
Observations	4,282	4,282

Notes: Sample includes respondents whose children were interviewed in Sweep 5 of National Child Development Study, 1991. The outcome is age-standardized. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1.

Table B2. Trajectories of multigenerational effects. Three most deprived vs. Two less deprived neighbourhood quintiles

VARIABLES	(1) Cognitive skills	(2) Socio-emotional Behaviour
Trajectory/Ref: Stable Deprived		
Downward	0.092	0.085
	(0.060)	(0.068)
Upward	0.074	0.064
	(0.050)	(0.054)
Stable Non-Deprived	0.116*	0.110*
	(0.058)	(0.062)
Child Age	0.023***	0.019***
	(0.005)	(0.005)
Child Sex/Ref: Male		

Female	0.083*	-0.005
	(0.037)	(0.040)
Parent Gen, Sex/Ref: Male		
Female	-0.040	0.117**
	(0.040)	(0.038)
Parent Gen, Mother age at birth	-0.004	-0.008+
	(0.003)	(0.004)
Parent Gen, Tenure/Ref: Not Owned		
Own	-0.076	0.013
	(0.050)	(0.058)
Parent Gen, Household Size	-0.018	0.010
	(0.013)	(0.014)
Parent Gen, Parental Educ/Ref: Low		
Medium	0.087+	0.005
	(0.050)	(0.049)
High	0.081	-0.127
	(0.091)	(0.099)
Parent Gen, Income	-0.021	0.002
	(0.033)	(0.038)
Parent Gen,Region/Ref: England and Wales		
Scotland	0.050	0.114
	(0.126)	(0.126)
Parent Gen,Urban/Ref: Rural		
Urban	0.090+	-0.023
	(0.049)	(0.049)
Child Gen, Tenure/Ref: Not Owned		
Own	0.070	0.065
	(0.051)	(0.053)
Child Gen, Household Size	-0.051*	-0.008
	(0.022)	(0.021)
Child Gen, Parental Educ/Ref: Low		
Medium	0.114	0.306***
	(0.074)	(0.086)
High	0.186*	0.400***
	(0.093)	(0.100)
Child Gen, Income	-0.025	0.022
	(0.023)	(0.024)
Child Gen,Region/Ref: England and Wales		
Scotland	0.026	0.045
	(0.123)	(0.127)
Child Gen,Urban/Ref: Rural		
Urban	-0.060	-0.090+
	(0.047)	(0.053)
Parental Cognitive Skills	0.129***	0.043*
	(0.022)	(0.021)
Parental Marital Status/Ref: Without Partner		
With Partner	0.008	0.158
	(0.078)	(0.098)
Parental Health/Ref: Poor		
Fair	0.165	0.392*

	(0.158)	(0.199)
Good	0.078	0.508*
	(0.150)	(0.201)
Constant	-0.063	-1.259***
	(0.239)	(0.293)
Observations	4,282	4,282

Notes: Sample includes respondents whose children were interviewed in Sweep 5 of National Child Development Study, 1991. The outcome is age-standardized. *** p<0.001, ** p<0.01, * p<0.05, + p<0.1.

Appendix C

Figure C1. Step-by-step sample selection, full sample

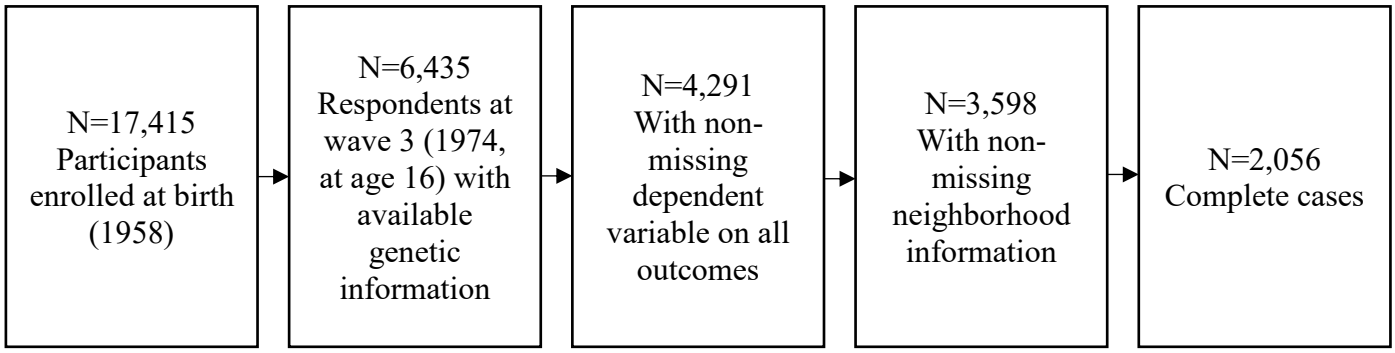


Figure C2. Step-by-step sample selection, experimental social housing sample

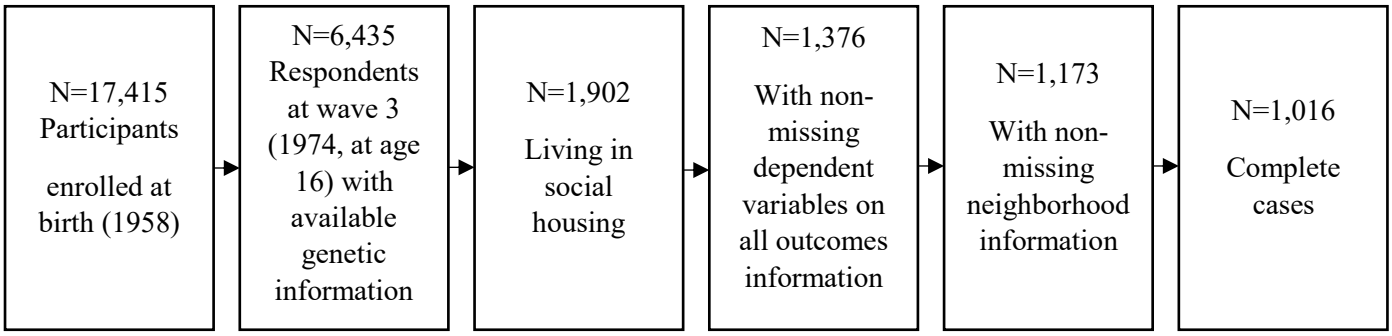


Table C1. R**egression models testing gene × neighbourhood interaction explaining cognitive ability for the full sample in the UK**

Cognitive Ability	(1)	(2)	(3)	(4)	(5)	(6)
Neighbourhood Deprivation Index (NDI)	0.343***	0.121***	0.124***	0.123***	0.122***	0.123***
	(0.024)	(0.026)	(0.025)	(0.025)	(0.025)	(0.025)
Polygenic Score (PGS)			0.358***	0.363***	0.256***	0.218**
			(0.026)	(0.056)	(0.065)	(0.068)
NDI × PGS				0.008	-0.010	-0.031
				(0.021)	(0.021)	(0.023)
Parental Education (PE, ref: *low*) *high*		0.333***	0.275***	0.276***	0.290***	0.287***
		(0.048)	(0.047)	(0.047)	(0.047)	(0.047)
PE *high* × PGS					0.163***	0.149**
					(0.047)	(0.047)
School Quality (SQ, ref: *low*)		0.300***	0.289***	0.291***	0.288***	0.294***
medium		(0.057)	(0.055)	(0.055)	(0.055)	(0.055)
high		0.818***	0.746***	0.748***	0.742***	0.733***
		(0.060)	(0.058)	(0.058)	(0.058)	(0.058)
SQ (medium) ×						0.067

PGS					(0.058)
SQ (high) × PGS					0.129*
					(0.055)
Urbanization (ref: *rural*),	0.051	0.072	0.069	0.068	0.067
urban	(0.052)	(0.051)	(0.051)	(0.051)	(0.051)
urban×PGS			0.035	0.042	0.033
			(0.053)	(0.053)	(0.054)
Sex (ref: *male*), *female*	-0.290***	- 0.267***	- 0.267***	- 0.271***	- 0.273***
	(0.044)	(0.043)	(0.043)	(0.043)	(0.043)
female×PGS			-0.061	-0.060	-0.062
			(0.042)	(0.042)	(0.042)
Household Size	-0.087***	-0.071**	-0.070**	-0.068**	-0.068**
	(0.024)	(0.023)	(0.023)	(0.023)	(0.023)
Number of Siblings (ref: *0*), 1-3 siblings	-0.075	-0.059	-0.060	-0.066	-0.073
	(0.085)	(0.086)	(0.086)	(0.085)	(0.086)
4+ siblings	-0.478***	- 0.455***	- 0.459***	- 0.463***	- 0.470***
	(0.110)	(0.109)	(0.109)	(0.108)	(0.109)
PC 1	43.134	-33.673	-32.364	-33.365	-35.988
	(38.554)	(24.458)	(24.233)	(23.965)	(24.399)
PGS×PC1	-65.196	46.787	44.986	46.400	49.996
	(54.083)	(34.547)	(34.228)	(33.845)	(34.463)
PC2	34.441	30.426	30.698	29.159	31.696
	(43.072)	(35.748)	(35.771)	(35.638)	(35.682)
PGS×PC2	- 162.579***	-48.968	-48.779	-46.362	-51.127
	(37.456)	(35.946)	(35.769)	(34.977)	(35.339)
PC3	-7.786	-4.448	-3.809	-6.404	-7.413
	(31.227)	(29.949)	(29.992)	(30.063)	(30.061)
PGS×PC3	-85.608**	-58.806*	-61.886*	-60.301*	-61.036*
	(31.525)	(28.409)	(28.394)	(28.731)	(29.108)
PC4	35.210***	1.190	1.109	0.214	0.988
	(8.611)	(7.833)	(7.838)	(7.761)	(7.817)
PGS×PC4	181.507***	13.255	13.121	7.635	11.574
	(44.180)	(39.272)	(39.259)	(38.794)	(39.064)
PC5	-35.688	-14.669	-15.206	-15.781	-17.099
	(28.647)	(26.473)	(26.533)	(26.711)	(27.015)
PGS×PC5	8.473	-19.406	-18.936	-21.362	-21.982
	(17.764)	(13.970)	(14.015)	(14.239)	(14.463)
PC6	-25.968	-43.086	-44.088	-39.816	-41.296
	(35.202)	(33.454)	(33.466)	(33.423)	(33.654)
PGS×PC6	26.151	-21.837	-20.564	-18.532	-19.873
	(34.093)	(29.755)	(30.025)	(30.026)	(30.559)
PC7	-11.802	4.366	3.810	0.365	-4.080
	(33.720)	(32.791)	(32.895)	(32.858)	(32.838)
PGS×PC7	54.030	-15.204	-18.967	-20.061	-18.294

		(33.189)	(28.820)	(29.256)	(29.518)	(29.783)
PC8		-0.521	-0.705	-0.759	-0.497	-0.309
		(2.032)	(1.853)	(1.858)	(1.867)	(1.870)
PGS×PC8		-0.850	-1.099	-0.967	-0.890	-0.878
		(1.777)	(1.495)	(1.499)	(1.517)	(1.523)
PC9		7.976	5.031	4.650	3.991	3.513
		(27.183)	(28.050)	(28.125)	(28.506)	(28.730)
PGS×PC9		-3.517	-27.214	-30.250	-29.642	-28.392
		(29.567)	(26.197)	(26.187)	(26.671)	(26.994)
PC10		-29.487***	3.155	3.199	4.027	4.800
		(7.975)	(7.338)	(7.350)	(7.421)	(7.585)
PGS×PC10		-54.502***	1.502	1.194	3.011	4.534
		(12.792)	(11.569)	(11.584)	(11.762)	(12.058)
Constant	0.039	0.208+	0.130	0.128	0.110	0.116
	(0.024)	(0.123)	(0.120)	(0.120)	(0.121)	(0.121)
Observations	2,506	2,506	2,506	2,506	2,506	2,506
R-squared	0.075	0.249	0.302	0.302	0.306	0.307

Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1; Data: NCDS, Sweep 3

Table C2. R**egression models testing gene × neighbourhood interaction explaining academic motivation for the full sample in the UK**

Academic Motivation	(1)	(2)	(3)	(4)	(5)	(6)
Neighbourhood Deprivation Index (NDI)	0.083***	0.044**	0.045**	0.046**	0.046**	0.046**
	(0.012)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Polygenic Score (PGS)			0.092***	0.072**	0.024	0.015
			(0.013)	(0.025)	(0.030)	(0.031)
NDI × PGS				-0.016	-0.024*	-0.031*
				(0.012)	(0.012)	(0.012)
Parental Education		0.119***	0.105***	0.105***	0.111***	0.110***
(PE, ref: *low*) *high*		(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
PE *high* × PGS					0.072**	0.067**
					(0.024)	(0.025)
School Quality (SQ, ref: *low*)		-0.012	-0.015	-0.017	-0.018	-0.017
medium		(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
high		0.052+	0.034	0.035	0.032	0.026
		(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
SQ (medium) × PGS						-0.003
						(0.030)
SQ (high) × PGS						0.053+
						(0.029)
Urbanization (ref: *rural*), *urban*		0.008	0.013	0.013	0.013	0.012
		(0.028)	(0.027)	(0.027)	(0.027)	(0.027)

urban×PGS			0.032	0.036	0.033
			(0.026)	(0.026)	(0.026)
Sex (ref: *male*), *female*	0.108***	0.114***	0.115***	0.113***	0.113***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
female×PGS			-0.008	-0.007	-0.011
			(0.023)	(0.023)	(0.023)
Household Size	-0.025+	-0.021	-0.020	-0.019	-0.019
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Number of Siblings (ref: *0*),	-0.127**	-0.123**	-0.125**	-0.128**	-0.132**
1-3 siblings					
	(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
4+ siblings	-	-	-	-	-
	0.286***	0.281***	0.284***	0.285***	0.288***
	(0.060)	(0.060)	(0.060)	(0.060)	(0.060)
PC 1	3.348	-16.327	-15.518	-15.960	-16.325
	(14.165)	(12.303)	(12.333)	(12.196)	(12.254)
PGS×PC1	-7.279	21.407	20.308	20.934	21.374
	(19.894)	(17.308)	(17.353)	(17.161)	(17.245)
PC2	-16.002	-17.031	-17.245	-17.926	-16.989
	(19.220)	(17.748)	(17.639)	(17.687)	(17.696)
PGS×PC2	-43.394*	-14.290	-13.548	-12.479	-15.268
	(17.204)	(17.114)	(17.100)	(16.990)	(17.083)
PC3	0.903	1.759	1.342	0.194	0.094
	(16.224)	(16.796)	(16.816)	(16.951)	(16.823)
PGS×PC3	-26.065+	-19.199	-21.512	-20.811	-22.356
	(15.172)	(16.413)	(16.451)	(16.610)	(16.416)
PC4	10.647**	1.932	2.351	1.956	2.424
	(3.713)	(3.910)	(3.903)	(3.895)	(3.907)
PGS×PC4	57.313**	14.212	16.423	13.997	16.403
	(18.779)	(19.563)	(19.505)	(19.456)	(19.499)
PC5	2.726	8.110	8.494	8.240	7.474
	(14.458)	(14.063)	(14.056)	(14.078)	(14.139)
PGS×PC5	-4.426	-11.568	-12.873	-13.946+	-14.582+
	(7.904)	(8.283)	(8.304)	(8.431)	(8.364)
PC6	-6.272	-10.657	-11.047	-9.158	-9.890
	(18.823)	(18.439)	(18.471)	(18.451)	(18.461)
PGS×PC6	12.809	0.516	-0.049	0.850	-0.333
	(15.713)	(15.101)	(15.229)	(15.201)	(15.266)
PC7	41.275*	45.417**	45.290**	43.767**	41.822*
	(16.481)	(16.382)	(16.343)	(16.493)	(16.497)
PGS×PC7	18.878	1.142	1.112	0.629	1.164
	(13.829)	(13.929)	(13.869)	(14.015)	(14.127)
PC8	-1.566	-1.613	-1.670+	-1.554	-1.477
	(0.993)	(0.988)	(0.988)	(0.996)	(0.995)
PGS×PC8	-0.640	-0.704	-0.737	-0.703	-0.690
	(0.742)	(0.722)	(0.723)	(0.727)	(0.728)
PC9	-17.799	-18.554	-18.558	-18.850	-19.026
	(12.119)	(12.002)	(12.039)	(12.043)	(12.048)
PGS×PC9	-0.023	-6.094	-5.928	-5.659	-5.059

		(10.877)	(10.757)	(10.801)	(10.782)	(10.824)
PC10		-6.742+	1.620	1.494	1.861	2.256
		(3.466)	(3.732)	(3.676)	(3.688)	(3.735)
PGS×PC10		-8.900	5.447	5.241	6.045	6.802
		(5.520)	(5.812)	(5.673)	(5.693)	(5.785)
Constant	0.018	0.130*	0.110+	0.112+	0.104	0.107
	(0.012)	(0.066)	(0.066)	(0.066)	(0.066)	(0.066)
Observations	2,506	2,506	2,506	2,506	2,506	2,506
R-squared	0.018	0.075	0.089	0.091	0.094	0.095

Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1; Data: NCDS, Sweep 3

Table C3. R**egression models testing gene × neighbourhood interaction explaining academic achievement for the full sample in the UK**

Academic Achievement	(1)	(2)	(3)	(4)	(5)	(6)
Neighbourhood Deprivation Index (NDI)	0.684***	0.192***	0.196***	0.203***	0.200***	0.205***
	(0.052)	(0.058)	(0.056)	(0.056)	(0.056)	(0.055)
Polygenic Score (PGS)			0.713***	0.825***	0.470***	0.320*
			(0.055)	(0.110)	(0.126)	(0.132)
NDI × PGS				-0.073	-0.132*	-0.222***
				(0.051)	(0.052)	(0.055)
Parental Education (PE, ref: *low*) *high*		0.813***	0.700***	0.704***	0.747***	0.738***
		(0.093)	(0.091)	(0.091)	(0.091)	(0.091)
PE *high* × PGS					0.537***	0.473***
					(0.095)	(0.094)
School Quality (SQ, ref: *low*)		0.511***	0.489***	0.486***	0.478***	0.499***
medium		(0.118)	(0.115)	(0.116)	(0.115)	(0.116)
high		1.649***	1.505***	1.511***	1.491***	1.442***
		(0.122)	(0.117)	(0.117)	(0.117)	(0.115)
SQ (medium) × PGS						0.203
						(0.126)
SQ (high) × PGS						0.594***
						(0.112)
Urbanization (ref: *rural*),		-0.119	-0.078	-0.069	-0.073	-0.080
urban		(0.106)	(0.104)	(0.103)	(0.103)	(0.103)
urban×PGS				-0.093	-0.069	-0.108
				(0.111)	(0.111)	(0.110)
Sex (ref: *male*), *female*		-0.108	-0.063	-0.060	-0.074	-0.082
		(0.090)	(0.087)	(0.087)	(0.087)	(0.086)

female×PGS			-0.075	-0.072	-0.093
			(0.091)	(0.089)	(0.088)
Household Size	-0.166**	-0.133**	-0.135**	-0.128*	-0.129**
	(0.051)	(0.050)	(0.050)	(0.050)	(0.049)
Number of Siblings (ref: *0*), 1-3 siblings	-0.274	-0.242	-0.237	-0.256	-0.296
	(0.187)	(0.182)	(0.182)	(0.182)	(0.181)
4+ siblings	-0.974***	-0.929***	-0.918***	-0.930***	-0.966***
	(0.236)	(0.231)	(0.232)	(0.230)	(0.229)
PC 1	134.796+	-17.881	-20.451	-23.751	-33.310
	(70.978)	(44.065)	(44.013)	(41.447)	(42.798)
PGS×PC1	-201.205*	21.397	25.157	29.821	42.714
	(99.682)	(62.302)	(62.221)	(58.655)	(60.600)
PC2	34.551	26.568	24.453	19.374	30.710
	(102.732)	(83.475)	(83.177)	(83.482)	(83.048)
PGS×PC2	-339.249***	-113.411	-105.895	-97.924	-122.887+
	(82.355)	(71.285)	(71.154)	(69.257)	(69.712)
PC3	-19.834	-13.198	-15.835	-24.396	-27.931
	(61.774)	(62.045)	(61.618)	(62.064)	(61.231)
PGS×PC3	-232.167***	-178.890**	-180.676**	-175.446**	-183.281**
	(65.173)	(63.767)	(62.675)	(63.572)	(62.866)
PC4	93.601***	25.975	27.651	24.699	28.809+
	(17.561)	(17.185)	(17.137)	(16.760)	(16.579)
PGS×PC4	471.093***	136.639	144.994+	126.895	147.893+
	(90.138)	(87.082)	(86.757)	(84.830)	(83.876)
PC5	-103.108+	-61.326	-62.140	-64.035	-70.921
	(55.149)	(51.976)	(51.735)	(51.502)	(51.225)
PGS×PC5	-3.302	-58.720*	-61.684*	-69.686*	-73.909**
	(32.657)	(29.100)	(28.975)	(28.852)	(28.528)
PC6	25.606	-8.420	-8.142	5.950	-1.325
	(71.652)	(68.050)	(67.865)	(67.881)	(68.030)
PGS×PC6	87.268	-8.123	-18.035	-11.331	-19.779
	(74.150)	(73.475)	(72.540)	(73.544)	(71.699)
PC7	41.598	73.737	75.139	63.775	42.835
	(67.054)	(63.515)	(63.482)	(63.036)	(62.726)
PGS×PC7	145.918*	8.294	0.566	-3.041	4.435
	(66.567)	(58.190)	(58.666)	(57.278)	(56.377)
PC8	-1.634	-2.001	-1.972	-1.107	-0.240
	(4.191)	(3.865)	(3.854)	(3.835)	(3.826)
PGS×PC8	-1.595	-2.090	-1.945	-1.690	-1.608
	(3.619)	(3.113)	(3.122)	(3.091)	(3.045)
PC9	43.965	38.109	39.790	37.614	35.481
	(49.236)	(46.550)	(46.291)	(46.446)	(46.449)
PGS×PC9	44.182	-2.923	-5.931	-3.923	2.156
	(57.819)	(50.589)	(49.508)	(49.802)	(49.089)
PC10	-62.807***	2.078	0.749	3.481	7.324
	(17.466)	(15.425)	(15.241)	(15.330)	(15.107)

PGS×PC10		-116.305***	-4.981	-7.792	-1.798	5.699
		(28.434)	(24.865)	(24.479)	(24.666)	(24.218)
Constant	4.181***	4.404***	4.249***	4.243***	4.184***	4.216***
	(0.050)	(0.261)	(0.250)	(0.250)	(0.251)	(0.250)
Observations	2,506	2,506	2,506	2,506	2,506	2,506
R-squared	0.071	0.242	0.292	0.293	0.302	0.309

Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1; Data: NCDS, Sweep 3 and 4(academic achievement).

Table C4. R**egression models testing gene × neighbourhood interaction explaining cognitive ability for individuals in social housing in the UK**

Cognitive Ability	(1)	(2)	(3)	(4)	(5)	(6)
Neighbourhood Deprivation Index (NDI)	0.049	-0.028	-0.015	-0.016	-0.013	-0.004
	(0.038)	(0.040)	(0.039)	(0.039)	(0.039)	(0.039)
Polygenic Score (PGS)			0.297***	0.464***	0.346**	0.261*
			(0.047)	(0.106)	(0.112)	(0.115)
NDI × PGS				-0.003	-0.007	-0.041
				(0.039)	(0.039)	(0.039)
Parental Education (PE, ref: *low*) *high*		0.138*	0.142*	0.146*	0.148*	0.144*
		(0.070)	(0.069)	(0.069)	(0.068)	(0.068)
PE *high* × PGS					0.234***	0.238***
					(0.068)	(0.068)
School Quality (SQ, ref: *low*)		0.388***	0.396***	0.399***	0.394***	0.391***
medium		(0.086)	(0.084)	(0.085)	(0.085)	(0.085)
high		0.590***	0.574***	0.574***	0.573***	0.527***
		(0.113)	(0.109)	(0.110)	(0.109)	(0.107)
SQ (medium) × PGS						0.186*
						(0.092)
SQ (high) × PGS						0.365***
						(0.095)
Urbanization (ref: *rural*),		0.001	0.047	0.037	0.039	0.045
urban		(0.094)	(0.094)	(0.095)	(0.094)	(0.094)
urban×PGS				-0.118	-0.101	-0.128
				(0.105)	(0.103)	(0.105)
Sex (ref: *male*), *female*		-0.352***	-0.338***	-0.343***	-0.348***	-0.358***

	(0.070)	(0.069)	(0.069)	(0.068)	(0.068)
female×PGS			-0.135*	-0.131+	-0.105
			(0.069)	(0.067)	(0.067)
Household Size	-0.061+	-0.059+	-0.061+	-0.059+	-0.058+
	(0.036)	(0.035)	(0.035)	(0.035)	(0.035)
Number of Siblings (ref: *0*), 1-3 siblings	-0.288+	-0.249	-0.247	-0.246	-0.254+
	(0.160)	(0.159)	(0.156)	(0.154)	(0.152)
4+ siblings	-0.720***	-0.673***	-0.676***	-0.663***	-0.674***
	(0.184)	(0.183)	(0.180)	(0.177)	(0.176)
PC 1	-24.928	-38.875	-48.067	-49.509	-43.264
	(73.000)	(70.510)	(70.928)	(70.264)	(70.017)
PGS×PC1	-201.132**	-60.492	-62.057	-50.024	-51.919
	(66.773)	(61.968)	(62.220)	(61.158)	(62.255)
PC2	59.435	29.370	27.007	26.987	36.818
	(64.223)	(64.503)	(64.719)	(64.633)	(64.333)
PGS×PC2	-165.296*	-35.593	-43.889	-61.154	-43.080
	(73.126)	(76.329)	(76.288)	(75.086)	(73.393)
PC3	-27.705	-46.971	-45.932	-52.202	-60.167
	(57.999)	(57.565)	(56.686)	(56.563)	(56.727)
PGS×PC3	-180.289***	-159.804**	-161.105**	-157.830**	-162.564**
	(50.573)	(51.928)	(49.454)	(50.286)	(52.226)
PC4	-21.477	-41.070	-39.313	-47.209	-49.290
	(78.220)	(71.661)	(71.854)	(70.237)	(70.002)
PGS×PC4	228.009**	64.958	67.722	41.992	56.098
	(78.973)	(80.124)	(80.797)	(77.896)	(76.869)
PC5	-32.952	-27.858	-21.573	-26.698	-24.673
	(41.612)	(39.671)	(39.621)	(39.708)	(40.004)
PGS×PC5	47.819+	7.481	6.603	4.983	-2.601
	(25.302)	(25.078)	(24.443)	(24.198)	(24.843)
PC6	-63.914	-88.040	-91.640	-87.750	-79.133
	(59.874)	(59.506)	(59.418)	(59.194)	(59.057)
PGS×PC6	-13.197	-45.351	-49.643	-46.502	-38.398
	(64.138)	(61.906)	(61.513)	(60.635)	(60.669)
PC7	65.628	82.417	84.520	73.072	61.505
	(60.404)	(60.021)	(59.221)	(59.061)	(58.579)
PGS×PC7	-46.123	-98.316	-93.588	-101.935+	-83.983
	(60.559)	(60.428)	(59.596)	(57.892)	(57.266)
PC8	-5.531+	-5.832+	-5.937+	-5.000	-4.977
	(3.342)	(3.221)	(3.186)	(3.168)	(3.171)
PGS×PC8	3.293	2.060	2.225	3.384	2.533
	(2.764)	(2.654)	(2.599)	(2.619)	(2.648)
PC9	-2.681	-10.594	-8.774	-9.098	-12.444
	(45.636)	(49.472)	(48.430)	(49.659)	(49.980)
PGS×PC9	12.126	-7.112	-10.209	-5.128	-0.073
	(44.391)	(42.330)	(39.983)	(41.163)	(42.012)
PC10	14.577	27.124	24.189	23.278	24.959
	(50.805)	(49.232)	(49.306)	(48.866)	(48.656)

PGS×PC10		31.560	15.970	3.830	-0.934	9.414
		(55.773)	(51.775)	(52.002)	(49.877)	(49.332)
Constant	-0.440***	0.228	0.138	0.151	0.138	0.148
	(0.037)	(0.206)	(0.203)	(0.202)	(0.201)	(0.200)
Observations	1,016	1,016	1,016	1,016	1,016	1,016
R-squared	0.002	0.192	0.219	0.223	0.232	0.243

Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1; Data: NCDS, Sweep 3

Table C5. Regression models testing gene × neighbourhood interaction explaining academic motivation for individuals in social housing in the UK

Academic Motivation	(1)	(2)	(3)	(4)	(5)	(6)
Neighbourhood Deprivation Index (NDI)	0.021	0.016	0.020	0.024	0.025	0.026
	(0.021)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Polygenic Score (PGS)			0.101***	0.158**	0.113*	0.107*
			(0.025)	(0.049)	(0.051)	(0.054)
NDI × PGS				-0.039*	-0.040*	-0.042*
				(0.020)	(0.020)	(0.020)
Parental Education (PE, ref: *low*) *high*		0.088*	0.090*	0.090*	0.091*	0.092*
		(0.039)	(0.039)	(0.039)	(0.039)	(0.039)
PE *high* × PGS					0.089*	0.092*
					(0.036)	(0.036)
School Quality (SQ, ref: *low*)		-0.023	-0.020	-0.022	-0.024	-0.023
medium		(0.047)	(0.047)	(0.047)	(0.047)	(0.047)
high		-0.005	-0.010	-0.012	-0.012	-0.026
		(0.061)	(0.060)	(0.060)	(0.060)	(0.061)
SQ (medium) × PGS						-0.049
						(0.047)
SQ (high) × PGS						0.093+
						(0.052)
Urbanization (ref: *rural*), *urban*		-0.044	-0.028	-0.033	-0.033	-0.028
		(0.050)	(0.050)	(0.050)	(0.050)	(0.050)
urban×PGS				-0.035	-0.029	-0.027
				(0.048)	(0.048)	(0.047)
Sex (ref: *male*), *female*		0.034	0.039	0.040	0.038	0.037
		(0.039)	(0.039)	(0.039)	(0.039)	(0.039)
female×PGS				-0.054	-0.052	-0.053
				(0.036)	(0.035)	(0.036)
Household Size		-0.003	-0.002	-0.002	-0.001	-0.002
		(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Number of Siblings (ref: *0*), 1-3 siblings		-0.249**	-0.236**	-0.236**	-0.236**	-0.244**

		(0.081)	(0.082)	(0.082)	(0.082)	(0.082)
4+ siblings		-0.441***	-0.425***	-0.427***	-0.422***	-0.426***
		(0.098)	(0.099)	(0.099)	(0.099)	(0.099)
PC 1		31.558	26.827	18.860	18.314	17.414
		(37.816)	(37.426)	(37.812)	(37.557)	(37.649)
PGS×PC1		-51.671	-3.960	-3.423	1.132	-2.387
		(31.757)	(34.593)	(35.931)	(34.770)	(34.348)
PC2		-38.065	-48.264	-47.380	-47.387	-49.014
		(37.919)	(37.860)	(37.848)	(37.902)	(37.999)
PGS×PC2		-105.556**	-61.555+	-57.418	-63.953+	-64.053+
		(35.325)	(36.582)	(36.705)	(36.800)	(36.969)
PC3		-28.694	-35.230	-32.510	-34.884	-37.136
		(30.469)	(30.736)	(30.507)	(30.571)	(30.491)
PGS×PC3		-23.710	-16.761	-19.284	-18.044	-24.593
		(21.889)	(23.573)	(23.282)	(23.293)	(23.633)
PC4		10.757	4.110	3.628	0.639	-1.621
		(38.734)	(37.945)	(37.868)	(37.665)	(37.702)
PGS×PC4		57.725	2.411	10.913	1.173	1.597
		(37.401)	(39.426)	(39.629)	(39.507)	(39.752)
PC5		-10.318	-8.590	-4.172	-6.112	-6.517
		(23.515)	(21.769)	(22.278)	(22.115)	(22.297)
PGS×PC5		9.989	-3.695	-6.333	-6.947	-8.128
		(13.000)	(13.651)	(13.681)	(13.540)	(13.314)
PC6		14.943	6.758	7.584	9.057	9.554
		(34.629)	(34.771)	(34.733)	(34.791)	(34.762)
PGS×PC6		-53.360+	-64.268*	-66.019*	-64.830*	-61.114+
		(32.047)	(31.880)	(31.847)	(31.862)	(31.765)
PC7		62.142*	67.838*	67.459*	63.125*	59.779*
		(31.166)	(30.333)	(30.421)	(30.678)	(30.431)
PGS×PC7		10.307	-7.399	-6.768	-9.928	-7.914
		(28.784)	(27.304)	(27.796)	(27.712)	(27.578)
PC8		-2.083	-2.185	-2.053	-1.698	-1.543
		(1.900)	(1.837)	(1.853)	(1.870)	(1.852)
PGS×PC8		1.476	1.057	0.989	1.427	1.327
		(1.402)	(1.364)	(1.379)	(1.392)	(1.381)
PC9		-18.108	-20.793	-17.866	-17.989	-20.324
		(20.958)	(20.126)	(20.287)	(20.101)	(20.275)
PGS×PC9		-3.615	-10.141	-8.076	-6.153	-10.155
		(18.508)	(18.422)	(18.468)	(18.236)	(18.646)
PC10		53.276+	57.533*	54.062*	53.717*	52.661+
		(27.253)	(27.224)	(27.270)	(27.258)	(27.195)
PGS×PC10		5.758	0.469	-6.662	-8.466	-10.203
		(26.062)	(25.453)	(25.063)	(24.605)	(24.575)
Constant	-0.094***	0.173	0.142	0.144	0.139	0.143
	(0.019)	(0.114)	(0.115)	(0.115)	(0.115)	(0.114)
Observations	1,016	1,016	1,016	1,016	1,016	1,016
R-squared	0.001	0.074	0.086	0.090	0.095	0.099

Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1; Data: NCDS, Sweep 3.

Table C6. Regression models testing gene × neighbourhood interaction explaining academic achievement for individuals in social housing in the UK

Academic Achievement	(1)	(2)	(3)	(4)	(5)	(6)
Neighbourhood Deprivation Index (NDI)	0.158*	0.003	0.024	0.035	0.040	0.058
	(0.077)	(0.085)	(0.085)	(0.085)	(0.084)	(0.083)
Polygenic Score (PGS)			0.504***	0.850***	0.647**	0.469+
			(0.097)	(0.224)	(0.235)	(0.244)
NDI × PGS				-0.195*	-0.202*	-0.273**
				(0.098)	(0.096)	(0.097)
Parental Education (PE, ref: *low*) *high*		0.286*	0.294*	0.295*	0.298*	0.292*
		(0.137)	(0.135)	(0.135)	(0.135)	(0.133)
PE *high* × PGS					0.405**	0.415**
					(0.146)	(0.144)
School Quality (SQ, ref: *low*)		0.520**	0.533**	0.527**	0.519**	0.512**
medium		(0.173)	(0.171)	(0.170)	(0.171)	(0.170)
high		1.057***	1.030***	1.011***	1.010***	0.908***
		(0.223)	(0.218)	(0.218)	(0.216)	(0.212)
SQ (medium) × PGS						0.347+
						(0.191)
SQ (high) × PGS						0.799***
						(0.218)
Urbanization (ref: *rural*),		-0.319+	-0.242	-0.261	-0.259	-0.243
urban		(0.181)	(0.181)	(0.182)	(0.182)	(0.182)
urban×PGS				-0.346	-0.316	-0.370+
				(0.221)	(0.222)	(0.222)
Sex (ref: *male*), *female*		-0.251+	-0.227+	-0.228+	-0.238+	-0.259+
		(0.137)	(0.136)	(0.135)	(0.134)	(0.133)
female×PGS				-0.116	-0.109	-0.057
				(0.146)	(0.145)	(0.144)
Household Size		-0.084	-0.080	-0.085	-0.081	-0.080
		(0.075)	(0.075)	(0.075)	(0.074)	(0.073)
Number of Siblings (ref: *0*),		-0.928**	-0.861**	-0.854**	-0.852**	-0.872**

1-3 siblings						
		(0.329)	(0.320)	(0.314)	(0.311)	(0.307)
4+ siblings		-1.594***	-1.514***	-1.510***	-1.487***	-1.513***
		(0.377)	(0.369)	(0.363)	(0.360)	(0.353)
PC 1		155.625	131.974	98.328	95.834	107.975
		(153.256)	(146.285)	(146.299)	(146.246)	(145.125)
PGS×PC1		-533.363**	-294.861+	-276.649+	-255.834+	-261.838+
		(171.007)	(154.311)	(145.766)	(150.953)	(155.790)
PC2		12.430	-38.554	-40.436	-40.471	-21.485
		(126.022)	(124.304)	(123.622)	(124.644)	(122.230)
PGS×PC2		-273.833+	-53.879	-38.956	-68.824	-32.153
		(152.551)	(152.033)	(149.212)	(149.749)	(149.167)
PC3		-59.861	-92.533	-79.507	-90.354	-107.921
		(112.857)	(113.288)	(110.519)	(110.541)	(110.132)
PGS×PC3		-292.847**	-258.109*	-260.493*	-254.829*	-268.457*
		(102.873)	(108.654)	(101.098)	(103.258)	(107.529)
PC4		100.347	67.120	69.383	55.724	50.110
		(153.051)	(142.229)	(142.481)	(139.456)	(138.336)
PGS×PC4		502.119**	225.611	265.742	221.230	250.157
		(157.907)	(161.556)	(166.128)	(161.493)	(161.519)
PC5		-129.691+	-121.052	-103.524	-112.390	-108.523
		(78.235)	(76.609)	(76.338)	(76.504)	(76.627)
PGS×PC5		53.539	-14.867	-26.943	-29.746	-45.882
		(53.134)	(54.159)	(52.178)	(52.517)	(54.334)
PC6		-87.416	-128.329	-120.213	-113.482	-95.666
		(119.034)	(119.113)	(119.340)	(118.842)	(119.050)
PGS×PC6		-21.672	-76.199	-92.345	-86.912	-68.166
		(130.458)	(130.572)	(130.481)	(129.058)	(127.238)
PC7		293.342*	321.814**	319.701**	299.897*	274.341*
		(127.241)	(122.710)	(120.622)	(121.106)	(120.322)
PGS×PC7		124.027	35.517	38.323	23.882	61.598
		(125.444)	(121.784)	(118.960)	(116.505)	(115.143)
PC8		-16.482*	-16.993*	-16.065*	-14.443*	-14.303*
		(7.416)	(7.034)	(6.929)	(6.992)	(6.962)
PGS×PC8		-1.418	-3.509	-3.673	-1.668	-3.458
		(5.940)	(5.703)	(5.572)	(5.615)	(5.648)
PC9		-10.764	-24.183	-11.516	-12.077	-20.306
		(76.885)	(76.863)	(75.596)	(76.910)	(78.161)
PGS×PC9		40.336	7.711	17.764	26.553	34.379
		(89.756)	(89.033)	(85.435)	(86.373)	(88.112)
PC10		137.302	158.579+	145.378	143.803	146.571
		(94.754)	(91.938)	(91.847)	(91.681)	(91.296)
PGS×PC10		103.882	77.443	51.246	43.005	62.973
		(114.843)	(107.602)	(105.966)	(104.009)	(103.985)
Constant	3.203***	4.686***	4.534***	4.547***	4.525***	4.547***
	(0.072)	(0.451)	(0.438)	(0.433)	(0.435)	(0.432)
Observations	1,016	1,016	1,016	1,016	1,016	1,016

R-squared	0.005	0.174	0.194	0.201	0.208	0.221

Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1; Data: NCDS, Sweep 3 and 4(academic achievement).

Table C7. Summary table of results for sample composed of all individuals with non-missing a) genetic information, b) neighbourhood information, c) information on all outcome variables.

	Full Sample			Social Housing Sample		
	Cognitive Ability	Academic Motivation	Academic Achievement	Cognitive Ability	Academic Motivation	Academic Achievement
Neighbourhood Deprivation Index (NDI)	0.135***	0.044***	0.240***	-0.008	0.035+	0.052
	(0.021)	(0.012)	(0.045)	(0.037)	(0.021)	(0.075)
Polygenic Score (PGS)	0.248***	0.045	0.423***	0.261*	0.075	0.394+
	(0.061)	(0.029)	(0.118)	(0.111)	(0.051)	(0.231)
NDI × PGS	-0.028	-0.021*	-0.155***	-0.055	-0.040*	-0.257**
	(0.019)	(0.010)	(0.045)	(0.036)	(0.019)	(0.089)
Control Variables,						
Additive	X	X	X	X	X	X
Interactive	X	X	X	X	X	X
Constant	-0.016	0.107+	3.887***	0.154	0.154	4.343***
	(0.108)	(0.055)	(0.218)	(0.181)	(0.101)	(0.395)
Observations	3,598	3,598	3,598	1,173	1,173	1,173
R-squared	0.287	0.082	0.295	0.219	0.084	0.207

Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Data: NCDS, Sweep 3 and 4 (academic achievement). Not shown additive controls include household size, number of siblings and the first 10 principal components of genetic data; interactive controls include gender and urbanization.

Table C8. Summary table of results sample composed of all individuals with non-missing a) genetic information, b) neighbourhood information.
Notes: Robust standard errors (SE) in parentheses; SE clustered by neighbourhood LSOA;

	Full Sample			Social Housing Sample		
	Cognitive Ability	Academic Motivation	Academic Achievement	Cognitive Ability	Academic Motivation	Academic Achievement
Neighbourhood Deprivation Index (NDI)	0.146***	0.050***	0.266***	0.018	0.034+	0.064
	(0.020)	(0.011)	(0.039)	(0.034)	(0.019)	(0.068)
Polygenic Score (PGS)	0.276***	0.053*	0.458***	0.234*	0.077	0.449*
	(0.057)	(0.026)	(0.107)	(0.102)	(0.049)	(0.199)
NDI × PGS	-0.030	-0.019*	-0.123**	-0.033	-0.037*	-0.179*
	(0.018)	(0.010)	(0.039)	(0.034)	(0.017)	(0.077)
Control Variables,						
Additive	X	X	X	X	X	X
Interactive	X	X	X	X	X	X
Constant	-0.084	0.074	3.902***	0.126	0.166+	4.172***
	(0.101)	(0.051)	(0.200)	(0.173)	(0.096)	(0.361)
Observations	4,205	4,069	4,618	1,376	1,335	1,449
R-squared	0.276	0.081	0.276	0.206	0.080	0.192

*** p<0.001, ** p<0.01, * p<0.05, + p<0.1. Data: NCDS, Sweep 3 and 4 (academic achievement). Not shown additive controls include household size, number of siblings and the first 10 principal components of genetic data; interactive controls include gender and urbanization.

Table C9: Simulation analysis, inflation of estimates due to population-based heterogeneity . SNP-based heritability (h^2_{SNP}) of group specific homogeneous phenotypes stratified by educational group ($h^2_{SNPxEdu}$).

	h^2_{SNP} (SE)	$h^2_{SNPxEdu}$ (SE)	N
Education Sim	0.36 (0.076)	0.000001 (0.115)	6,435

Notes: Simulated education phenotype with heritability of 0.5 based on GWAS summary statistics by Lee et al. (2018). The simulated heritability of 0.5 reduces in the estimation to 0.36 (0.076) since the GRM is based not only on quantitative trait loci.

In this analysis, I use Genome-wide Complex Trait Analysis (gcta, Yang et al. 2011) to simulate outcome variables with a heritability of 0.5 for reasonable power (Robinson et al. 2017), based on discovered genetic associations for education (Lee et al. 2018), within the three main neighbourhood subgroups in the NCDS. Subsequently, I pool the group specific phenotypes

and estimate a stratified heritability analysis. I find no evidence that the within group simulations do not extend across groups and therefore that population genetic differences between the groups would bias our results. For more information on the method, see Tropf et al. (2017).

Résumé

Au-delà de la question « Les quartiers sont-ils importants »?

Étude des effets hétérogènes des quartiers sur le développement des jeunes au Royaume-Uni

Cette thèse porte sur l'effet des caractéristiques du quartier résidentiel sur les dimensions cognitives et non-cognitives du développement des jeunes au Royaume-Uni. Je m'appuie sur la National Child Development Study (NCDS), une étude de cohorte en cours qui comprend 17 415 personnes toutes nées la même semaine en 1958 et qui ont été interrogées à différents stades de leur vie. Je me concentre en particulier sur les compétences cognitives et non-cognitives, car il est bien connu que le développement de ces compétences et aptitudes est important non seulement pour les résultats scolaires, mais aussi pour la réussite globale du parcours de vie (Cunha et Heckman, 2007 ; Blair et Razza, 2007 ; Duckworth et Seligman, 2005 ; Duncan et al., 2011 ; Valiente et al., 2010 ; Lleras, 2008).

La littérature a mis en évidence la façon dont la transmission de caractéristiques particulières, y compris l'avantage éducatif, est le résultat de processus se déroulant non seulement à l'intérieur, mais aussi à l'extérieur de la famille (Cavalli-Sforza et Feldman, 1981 ; Bisin et Verdier, 2011). Les enfants sont éduqués par l'éducation parentale, mais aussi par des processus de socialisation qui se déroulent en dehors du ménage, par exemple dans l'école qu'ils fréquentent ou dans le quartier où ils vivent, si ces derniers sont de qualité suffisante en termes de capital humain et de ressources (Patacchini et Zenou, 2011).

Les quartiers représentent en effet le contexte le plus fin dans lequel les individus grandissent et interagissent au quotidien, influençant leur développement et, partant, leurs trajectoires de vie au fil du temps (Sampson et al., 2002 ; Sampson, 2012). Avec leurs contextes communautaires et leurs réseaux sociaux, ils constituent des structures sociales de niveau intermédiaire capables d'influencer les compétences, les attitudes et les comportements de chacun. Malgré l'importance du rôle joué par les quartiers dans le développement des jeunes, la littérature consacrée aux quartiers reconnaît rarement qu'il n'existe pas de solution unique pour les effets liés aux quartiers. Les auteurs ont en effet souligné que la littérature doit s'éloigner de la question "les quartiers ont-ils de l'importance ?", qui a représenté le cœur des efforts de recherche au cours des dernières décennies. Les chercheurs devraient plutôt se concentrer sur l'exploration de l'hétérogénéité des effets de voisinage, en essayant de mieux comprendre les conditions spécifiques dans lesquelles les effets de voisinage peuvent se produire et les mécanismes sous-jacents connexes (Sharkey et Faber, 2014).

Compte tenu de tous ces éléments, cette thèse apporte une contribution théorique, méthodologique et empirique à la recherche sur les effets de voisinage.

D'un point de vue théorique, dans cette thèse, je justifie l'attention portée à la diversité des résultats étudiés dans la littérature sur les quartiers. Les chercheurs se sont généralement

concentrés sur un ensemble de résultats comprenant les compétences cognitives et les résultats scolaires, l'emploi, la santé physique et mentale, ainsi que les trajectoires résidentiels plus tard dans la vie (Brooks-Gunn et al., 1993 ; Chauvin et Parizot, 2009 ; Mayer et Jencks 1989 ; Sampson et al. 2008 ; Sampson 2012 ; Sharkey et Farber 2014). En revanche, les compétences non-cognitives des individus ont fait l'objet de beaucoup moins d'attention. Les compétences non-cognitives sont aussi parfois appelées "compétences socio-émotionnelles", "compétences douces", "compétences similaires" ou "compétences de caractère" et se réfèrent aux capacités qui permettent aux individus de faire face efficacement aux exigences et aux défis de la vie quotidienne (OMS, 2001). Les spécialistes des quartiers ont généralement analysé les dimensions non-cognitives des individus de manière très générale, en se concentrant par exemple sur les grossesses chez les adolescentes, la consommation de substances, la violence, le stress ou les mesures de comportement et de (mauvaise) conduite (Sampson et al., 2002). En revanche, les études portant sur les indicateurs proactifs des compétences non-cognitives, qui sont également plus strictement liés à l'école et au travail (Bowles et Gintis, 1976), sont toujours absentes de la littérature sociologique et doivent donc faire l'objet d'une théorisation supplémentaire.

En outre, cette thèse s'appuie sur la nécessité de reconnaître et de prendre en compte le fait que les quartiers ne sont pas une caractéristique statique de la vie des individus, vécue de manière uniforme par chacun d'entre eux (Lupton, 2003). C'est pourquoi j'insiste sur la nécessité d'éclairer davantage l'interaction entre les conditions individuelles et celles du quartier, car cela contribuerait grandement à souligner le rôle des quartiers dans la persistance des inégalités sociales. Comme le souligne Small (2004, p.176), les chercheurs devraient en effet "*use heterogeneity in responses to neighbourhood poverty as the starting point rather than [something] to ignore*".

Les travaux récents de Levy et al. (2019) et Levy (2019, 2021) ont jeté les bases de cette étude. Ils proposent quatre hypothèses théoriques concernant l'hétérogénéité des effets du quartier sur la réussite scolaire : avantage cumulatif, désavantage cumulatif, nivellement des avantages et avantage compensatoire. Ces hypothèses soulignent que les conditions de voisinage peuvent affecter les individus différemment, répondant ainsi à la nécessité de comprendre l'hétérogénéité. Cette hétérogénéité découle de divers contextes et conditions individuelles, qui agissent eux-mêmes comme des sources d'avantages ou de désavantages sociaux. Dans cette thèse, j'élargis ce cadre théorique de deux manières significatives. Premièrement, je prends en compte d'autres dimensions de l'avantage ou du désavantage individuel au-delà du statut socio-économique familial (SSE), telles que le sexe, les trajectoires

antérieures de désavantage dans le quartier et les gènes liés à l'éducation. Deuxièmement, j'explore et je teste des hypothèses théoriques alternatives, allant au-delà de la théorie prédominante du désavantage cumulatif, afin d'analyser l'hétérogénéité des effets de manière exhaustive.

D'un point de vue méthodologique, en exploitant la richesse des données du NCDS, je suis en mesure de contribuer à la littérature relativement restreinte qui fournit des preuves solides de l'effet hétérogène du contexte résidentiel. L'enquête NCDS recueille des informations sur une variété de domaines, allant du développement des compétences au contexte éducatif et familial, en passant par la situation économique et la vie de famille. S'appuyant sur ces sources, mon analyse est fondée sur une approche multidimensionnelle innovante de l'effet de l'environnement du quartier. Cette thèse exploitera en particulier des informations sur le lieu de résidence (Patacchini et Zenou, 2011), les compétences cognitives et non-cognitives (Carneiro et al., 2007; Joshi, 2014) et le patrimoine génétique (Davies et al., 2015). Les caractéristiques des quartiers sont extraites en faisant correspondre les identifiants géographiques individuels disponibles dans le NCDS avec les informations sur le « désavantage socio-économique » ou “deprivation”, des zones disponibles dans le recensement du Royaume-Uni (Patias et al., 2021).

En outre, j'accorde une attention particulière aux défis méthodologiques qui ont caractérisé la recherche sur les quartiers. La grande majorité des travaux sur les effets de voisinage ont été affectés par la question de la sélection des quartiers, à savoir le fait que les individus choisissent leur lieu de résidence, confondant le rôle du quartier avec les caractéristiques familiales endogènes. En revanche, ma stratégie empirique est élaborée dans le but d'obtenir des résultats robustes. Pour ce faire, j'adopte différentes méthodes. Dans deux des chapitres empiriques, je parviens à réduire les problèmes d'endogénéité en exploitant la procédure d'attribution des logements sociaux au cours des années 1970 au Royaume-Uni. Ce mécanisme présente en effet l'avantage de fournir une quasi-randomisation résidentielle, en s'appuyant sur un critère d'attribution basé sur le temps et en répartissant les bénéficiaires entre différents quartiers au sein de chaque autorité locale. Dans le chapitre suivant, j'effectue l'analyse principale en adoptant, en combinaison avec les techniques classiques des MCO, une stratégie empirique relativement récente définie comme l'approche de régression avec les résidus (RWR) (Wodtke, 2018 ; Wodtke et Almirall, 2017 ; Wodtke et al., 2020 ; Zhou et Wodtke, 2019). Cette méthode a déjà été appliquée dans le cadre de recherches longitudinales sur les quartiers (Levy et. al., 2019 ; Wodtke et al., 2016), car elle présente l'avantage de résoudre les problèmes liés aux facteurs de confusion induits par l'exposition.

D'un point de vue empirique, les contributions de cette thèse sont nombreuses.

Tout d'abord, afin de dresser un tableau théorique plus précis des effets hétérogènes des quartiers, il est important de reconsidérer les caractéristiques individuelles, telles que l'âge, le sexe et l'appartenance ethnique, qui ont été largement analysées dans le cadre de la recherche sur les quartiers, mais pour lesquelles les preuves n'ont souvent pas été concluantes. Dans le premier chapitre empirique, je passe en revue et réévalue le rôle joué par les désavantages du quartier sur un riche ensemble de résultats cognitifs et non-cognitifs et, surtout, la manière dont ces résultats varient en fonction du sexe. De nombreux travaux quantitatifs et qualitatifs dans le domaine des quartiers se sont concentrés sur cette dimension individuelle et ont conclu, dans l'ensemble, que les hommes et les femmes ont tendance à être affectés différemment par leur environnement résidentiel. Toutefois, les explications sont diverses et il est difficile de réconcilier les prévisions tirées de la littérature. L'une des considérations susceptibles d'avoir influencé les explications actuelles sur les effets sexospécifiques des quartiers est que, comme pour la littérature plus générale sur les quartiers, il n'existe pas de comptes rendus empiriques allant au-delà des comportements problématiques et se concentrant plutôt sur la manière dont l'environnement du quartier peut affecter le développement positif des compétences non-cognitives des garçons et des filles. Je soutiens que le fait de se concentrer sur ces aspects, en plus des compétences cognitives et des dimensions plus connues du comportement problématique, peut aider à démêler les mécanismes par lesquels le désavantage socio-économique de voisinage exerce des effets différents sur les jeunes hommes et les jeunes femmes. Conformément à la littérature antérieure, avec mes analyses j'ai constaté que le fait de vivre dans des zones plus défavorisées a un effet négatif global sur les dimensions cognitives et non-cognitives du développement des jeunes dans les années 1970s. Cependant, la désavantage socio-économique de voisinage affecte plus négativement les compétences cognitives, la motivation scolaire et les compétences d'employabilité des filles que celles des garçons, alors qu'aucune différence significative entre les sexes n'est détectée en ce qui concerne les problèmes de comportement. Pour donner un sens à ces résultats, je discute des mécanismes pertinents potentiels et, en particulier, du rôle du soutien communautaire et des stéréotypes de genre, qui tendent à être respectivement plus rares et plus importants dans les contextes plus défavorisés, affectant ainsi les aspirations éducatives des filles et, par conséquent, leur développement cognitif et non-cognitif global.

Deuxièmement, la littérature sur les quartiers bénéficierait d'une meilleure intégration du rôle du temps dans le domaine et, plus largement, de l'adoption d'une perspective de parcours de vie (Van Ham et al., 2016). Nous sommes de plus en plus conscients que les histoires de vie

et même au-delà, c'est-à-dire les trajectoires multigénérationnelles, affectent de manière critique la persistance des avantages et des désavantages au fil du temps (Mare, 2011). Par conséquent, les quartiers devraient être mieux conçus en tant que contexte de développement multigénérationnel et à long terme afin de comprendre toute la portée de la manière dont ils influencent l'inégalité et du moment où ils le font (Sharkey et Elwert, 2011 ; Alvarado et Cooperstock, 2021 ; Crowder et South, 2011 ; Quillian, 2003). Dans le deuxième chapitre empirique, j'analyse la mesure dans laquelle l'exposition multigénérationnelle à des conditions de voisinage défavorables affecte les compétences cognitives et le comportement socio-émotionnel au début de la vie. D'une part, j'estime l'effet indépendant et cumulatif de deux environnements de quartier consécutifs sur le développement des jeunes. La recherche suggère que le désavantage socio-économique au niveau du quartier, vécue non seulement par la génération dans laquelle les individus grandissent, mais aussi par la génération précédente, a le potentiel d'exercer un effet persistant au fil du temps (Sharkey and Elwert, 2010, 2011). D'autre part, j'accorde une attention particulière à la manière dont les trajectoires de quartier vécues sur deux générations affectent les résultats individuels. De nombreuses recherches se sont concentrées sur les trajectoires de mobilité sociale, estimant l'effet de la montée et de la descente dans l'échelle sociale entre différentes générations au sein d'une même famille (Pfeffer, 2014). Je me concentre ici sur la dimension relativement peu étudiée de la mobilité spatiale, en estimant l'impact différentiel de trajectoires stables, ascendantes et descendantes de désavantages liés au quartier sur deux générations. Ma première hypothèse s'aligne sur la recherche conventionnelle sur les quartiers, suggérant que le quartier actuel affecte le comportement socio-émotionnel, mais n'a pas d'impact significatif sur les compétences cognitives, ce qui est cohérent avec les études britanniques précédentes centré sur les années 1990s. La deuxième hypothèse explore l'effet intergénérationnel des environnements de quartier antérieurs sur les résultats des jeunes, confirmant que l'exposition au dénuement du quartier dans les générations précédentes affecte les compétences cognitives des générations suivantes. Toutefois, l'effet sur le comportement socio-émotionnel est moins solide sur le plan statistique. L'étude confirme également les deux dernières hypothèses, soulignant la nature cumulative, multigénérationnelle et durable des effets du quartier. L'exposition à un quartier défavorisé sur plusieurs générations consécutives a un impact négatif sur les résultats cognitifs et socio-émotionnels, ce qui renforce les théories du désavantage cumulatif selon lesquelles les avantages ou désavantages individuels, y compris le fait de résider dans des quartiers défavorisés ou aisés, s'additionnent au fil du temps, ce qui amplifie l'inégalité. En particulier, les jeunes qui vivent depuis longtemps dans des quartiers défavorisés sont les plus touchés, par

rapport aux jeunes dont la mobilité spatiale est plus variée, lorsqu'il s'agit de présenter des résultats négatifs sur le plan du développement.

Troisièmement, pour que le domaine progresse, nous devrions intégrer dans la recherche sur les quartiers des caractéristiques individuelles relativement nouvelles et peu étudiées, dépassant même les frontières de la sociologie. Sharkey et Faber (2014) soulignent en particulier la nécessité d'intégrer de nouvelles théories sur la façon dont les individus réagissent à leur environnement en fonction de leur susceptibilité individuelle. Dans le troisième chapitre empirique, je développe ce sujet en étudiant l'interaction entre l'environnement du quartier et les prédispositions génétiques individuelles pour l'éducation sur les résultats cognitifs, non-cognitifs et éducatifs. Pour ce faire, je m'appuie sur des cadres théoriques majeurs en sociologie de l'éducation et de la stratification sociale, tels que l'approche du capital culturel (Bourdieu et Passeron, 1990 ; Lamont et Lareau, 1988 ; Lareau, 2011) et le modèle de l'avantage compensatoire (Bernardi, 2014), ainsi que sur des hypothèses élaborées en génétique du comportement (Shanahan et Hofer, 2005), à savoir les modèles de Scarr-Rowe et de compensation, et, bien entendu, sur des théories générales concernant les effets de quartier. Les gènes se sont révélés être d'importants prédicteurs des résultats scolaires (Branigan et al., 2013 ; Silventoinen et al., 2020 ; Polderman et al., 2015) et les études en génétique du comportement ont souligné que les individus ont tendance à réagir différemment au même type de stimulus environnemental en fonction de leur génome (Ritz et al., 2017). Cependant, ce n'est que récemment que les sociologues ont commencé à intégrer la génétique dans les études sur la transmission intergénérationnelle du statut socio-économique (Liu, 2018). Une tradition de recherche bien établie considère l'interaction entre les gènes et les contextes socioéconomiques familiaux, constatant généralement que le fait d'être intégré dans une famille plus favorisée renforce positivement l'effet des gènes sur les résultats cognitifs et éducatifs (Baier et Lang, 2019 ; Erola et al., 2021 ; Figlio et al., 2017 ; Guo et Stearns, 2002 ; Lin, 2020). Inévitablement, une question se pose : si le contexte familial est si important pour façonner l'effet des gènes sur l'éducation, qu'en est-il du contexte du quartier ? Les conditions du quartier influencent-elles l'influence des prédispositions génétiques sur les différents résultats liés à l'éducation ? Et, plus généralement, le contexte du quartier amplifie-t-il, ou plutôt réduit-il, les inégalités éducatives préexistantes induites par le patrimoine génétique ? Pour répondre à ces questions, je réalise la première analyse de ce type qui teste les effets de l'interaction entre les gènes et l'environnement du quartier sur un ensemble complet de mesures liées à l'éducation. J'émets l'hypothèse qu'en raison de mécanismes de protection et d'efficacité collective plus forts dans les meilleurs quartiers, les effets génétiques sont compensés par rapport aux quartiers à faible statut socio-

économique. Je trouve des preuves qui soutiennent cette hypothèse pour la motivation et la réussite scolaires. Cependant, je ne trouve aucun effet distinct de zéro pour les capacités cognitives. Les explications des effets Scarr-Rowe trouvées dans les études sur l'interaction entre la génétique et le statut socioéconomique de la famille et de l'école reposent principalement sur les investissements directs relatifs que les parents et les enseignants ont tendance à faire dans leurs propres enfants. Au contraire, je postule ici que les environnements de voisinage peuvent agir de manière plus tacite et indirecte, notamment via l'effet des normes sociales, de la cohésion et de la stabilité de la communauté, donc globalement en offrant un environnement plus sûr et plus agréable pour les jeunes adolescents qui y grandissent. Ce point de vue s'aligne sur la littérature existante, selon laquelle les quartiers à forte pauvreté affectent les résultats scolaires en raison du manque d'opportunités, qui conduit à des valeurs et des normes aberrantes, à un affaiblissement des institutions sociales et à un accès limité aux voisins qui peuvent servir de modèles positifs et fournir des ressources tangibles pour le soutien (McBride Murry et al., 2011). Les individus caractérisés par un score polygénique élevé peuvent être plus résilients et ne pas subir les conséquences d'un tel contexte. Au contraire, les individus caractérisés par un score polygénique faible pourraient ne pas être aussi capables, restant ainsi "left behind" dans le contexte des zones les plus pauvres.

Dans l'ensemble, cette thèse apporte de nombreux éclairages à la littérature sur les inégalités spatiales et la stratification sociale. En me concentrant sur l'hétérogénéité des effets de voisinage, je suis en mesure de mieux cerner et comprendre les mécanismes qui sous-tendent l'influence du voisinage. Comme le soulignent Small et Feldman (2012), on ne sait toujours pas quelles voies d'influence du quartier peuvent être théoriquement pertinentes dans différentes circonstances. Dans cette thèse, les aspects sociaux de l'environnement du quartier semblent émerger comme des dimensions clés concernant la manière dont ils semblent influencer le développement cognitif et non-cognitif des jeunes. Ainsi, le premier chapitre empirique met en évidence la dimension " socioculturelle " du quartier en tant que voie critique influençant le comportement masculine ou féminine des jeunes du quartier par leurs attitudes et leurs croyances. Dans la dernière analyse empirique, je constate également que les quartiers exercent leur influence différemment des familles, en opérant de manière plus tacite et indirecte, plutôt qu'au moyen d'investissements directs. En outre, je dévoile et propose, bien que je ne les teste pas formellement, différents mécanismes par lesquels les environnements de quartier passés peuvent rester pertinents et leurs effets persister à travers les générations. Ces mécanismes sont tous liés, d'une manière ou d'une autre, à la reproduction socioculturelle des valeurs, des

attitudes et des comportements qui peut avoir lieu via la transmission du contexte ou en raison de l'héritage des inégalités en matière d'éducation, d'emploi et de santé.

Les résultats présentés dans cette thèse suggèrent également qu'il est important de repenser le rôle différentiel que les quartiers peuvent jouer lorsqu'ils influencent deux ensembles différents de compétences, cognitives et non-cognitives. Mes résultats semblent cohérents avec l'argument avancé par d'autres chercheurs selon lequel les quartiers sont particulièrement importants pour les résultats non-cognitifs (Gibbons et al., 2013 ; List et al., 2020), alors que les familles et les écoles pourraient être plus pertinentes pour le développement des compétences cognitives. L'une des raisons pourrait résider dans le fait que les compétences non-cognitives sont peut-être moins sensibles aux ressources et aux investissements parentaux que les compétences cognitives, et qu'elles réagissent davantage aux modèles de dynamiques d'interaction sociale enracinés dans la zone locale. Cela a des conséquences théoriques importantes, car les résultats non-cognitifs ont jusqu'à présent été peu étudiés dans le domaine du voisinage (à l'exception des comportements problématiques) par rapport aux résultats cognitifs et éducatifs.

Enfin, les désavantages liés au quartier impliquent une série de limites et de contraintes pour les individus. L'étude des conditions spatiales qui permettent aux individus de développer leurs compétences et, par conséquent, d'accroître leurs opportunités sociales tout au long de leur vie est donc essentielle pour comprendre plus largement la mesure dans laquelle la stratification sociale et les inégalités socio-économiques au sein du quartier fonctionnent et, éventuellement, pourraient être réduites, au fil du temps. Dans cette thèse, je réfléchis donc théoriquement au rôle joué par le quartier dans l'exacerbation des inégalités sociales. Un mérite important du cadre proposé par Levy (2019) est en effet de préciser que les quartiers jouent un rôle complexe dans la modération d'autres formes d'inégalité. Les théories de l'avantage et du désavantage cumulatifs prévoient toutes deux un élargissement des écarts d'inégalité au fil du temps. En revanche, l'hypothèse du nivellement des avantages et l'hypothèse compensatoire impliquent une réduction globale des écarts d'inégalité, bien que dans des directions différentes (car l'hypothèse du nivellement des avantages suppose une réduction des avantages préexistants, tandis que le modèle compensatoire suppose une compensation des désavantages préexistants). Dans tous les chapitres empiriques, deux des théories susmentionnées se vérifient. Dans les deux premières contributions empiriques, j'observe que l'exposition à un quartier défavorisé creuse des écarts d'inégalité préexistants. Dans l'une, il s'agit de l'écart entre les sexes, dû au manque d'éléments favorables aux femmes dans les quartiers, et, dans l'autre, de l'écart multigénérationnel dans les expériences antérieures de désavantage socio-économique, dû à des

formes passées et accumulées de désavantage. Dans le dernier chapitre empirique, cependant, je montre que les environnements de quartier positifs compensent les inégalités préexistantes. Ce dernier résultat donne de l'espoir en soulignant comment le fait de vivre dans des environnements de quartier de bonne qualité peut contribuer à interrompre le cycle du désavantage qui caractérise souvent les individus vivant dans des contextes plus défavorisés. Selon ce point de vue, il semble donc de plus en plus important de déplacer le débat théorique de l'exploration des conséquences des désavantages des quartiers à l'exploration des moyens par lesquels les avantages des quartiers peuvent améliorer l'histoire et les expériences des individus.

Le fait d'envisager le discours sur les quartiers sous cet angle apporte de nouvelles pistes de réflexion, car il souligne que les réponses politiques axées sur les zones urbaines et les communautés défavorisées peuvent avoir un impact significatif en contribuant à l'amélioration des niveaux d'éducation globaux et à la réduction des inégalités sociales. En 2019, le Parti conservateur du Royaume-Uni a annoncé pour la première fois la politique phare « Levelling Up », dont l'ambition est de réduire les déséquilibres entre les zones et les groupes sociaux et de transformer le pays en étendant les opportunités et la prospérité à toutes ses parties. Les conclusions des trois chapitres ont des implications politiques pertinentes, en particulier si l'on considère le récent programme politique établi pour le Royaume-Uni. Nous avons vu que les lieux et les quartiers sont importants pour les gens. Mais dans quelle mesure l'agenda gouvernemental l'a-t-il reconnu ? Dans une analyse critique, Overman (2022) affirme que le plan d'action proposé est encore largement orienté vers la réduction des écarts entre les régions du pays, plutôt que vers l'évaluation de l'effet de la politique sur les différentes personnes vivant dans des lieux différents. Une grande partie de l'attention (4 missions du gouvernement sur 12 au total) semble se concentrer sur la réduction des différences régionales en termes de productivité et d'opportunités économiques. Il en résulte qu'une attention plus limitée - et, par conséquent, des investissements moindres - ont été consacrés aux multiples obstacles qui caractérisent les endroits véritablement « left behind », tous liés non seulement à l'éducation et aux compétences, mais aussi aux services de garde d'enfants et de santé mentale et physique (Overman, 2022). En outre, cette approche montre que les politiques, qui se concentrent sur les différences régionales, semblent ignorer l'importance des géographies à plus petite échelle, comme les quartiers. Mais c'est typiquement à ce niveau local que les interactions et les échanges positifs entre les individus ont le plus de chances de se produire et que les communautés peuvent se sentir véritablement responsabilisées.

Les éléments de cette thèse soulignent l'importance d'investir non seulement dans l'augmentation des opportunités structurelles et économiques disponibles dans les zones les plus défavorisées, mais aussi dans cette forme d'infrastructure qui contribue à changer positivement les valeurs et les croyances qui prévalent dans les quartiers les plus pauvres. Selon ce point de vue, il est important, pour une politique globale de «Levelling Up », de viser des investissements structurels, par exemple dans les infrastructures publiques, mais aussi de promouvoir des valeurs immatérielles. Cela permet de soutenir la mise en œuvre de politiques visant à renforcer la cohésion sociale et l'efficacité collective, ce qui pourrait contribuer à renforcer le rôle "protecteur" de l'environnement du quartier. De même, mes résultats soutiennent les politiques de logement qui encouragent une plus grande mixité sociale et de logement, qui ont également été associées à une plus grande cohésion sociale (Van Kempen et Bolt, 2009). Ceci est de la plus haute importance, en particulier pour les individus les plus défavorisés socialement et financièrement, qui risquent souvent de rester "enfermés" dans leur groupe de désavantages (Dannefer, 2003). En ce qui concerne le développement des compétences, pour les jeunes défavorisés, la dimension du quartier peut être encore plus pertinente que celle de la famille (Patacchini et Zenou, 2011). En effet, les parents à faible revenu se heurtent à de multiples obstacles, tant socio-économiques que psychologiques, qui les empêchent de s'impliquer dans l'éducation et la croissance de leurs enfants (Lechuga-Pena et al., 2019). Dans ces conditions, les adolescents sont contraints de s'appuyer fortement sur les adultes résidents et les institutions du quartier (Wodtke et al., 2016). Les politiques susmentionnées peuvent donc contribuer à réduire le regroupement local des désavantages, ce qui a un effet positif sur les personnes défavorisées nées dans des familles plus pauvres.

Revenant à l'argument de l'isolement social de Wilson (1987), je soutiens ici que le « Levelling Up » doit donc consister à modifier et à améliorer la culture normative régnant dans les espaces « left behind ». Qu'est-ce que cela signifie en pratique ? Dans un sondage réalisé en 2021 (Local Trust, 2021) dans 225 quartiers de l'Angleterre appartenant aux 10 % des régions les plus défavorisées, les individus ont cité les "équipements collectifs" comme le domaine le plus critique (66 %) dans lequel ils estimaient ne pas recevoir leur juste part des ressources nationales, par rapport aux communautés voisines. Ce domaine est suivi de près par les projets communautaires tels que les installations sportives et de loisirs (58 %) et les lieux de rencontre en général (50 %). Il est intéressant de noter que l'investissement dans les opportunités d'emploi et la lutte contre le chômage n'arrive qu'en troisième position (53 %). Encore une fois, tout ceci semble apporter un soutien supplémentaire au fait que c'est l'infrastructure sociale et civique des quartiers qui pourrait également compter et qui a été ignorée jusqu'à présent, d'où la

nécessité d'équilibrer la création de nouvelles opportunités économiques avec l'investissement dans l'infrastructure sociale locale.

Bibliography

Aaronson, D. (1998). *Neighborhood dynamics*. Federal Reserve Bank of Chicago.

Abdellaoui, A., Hugh-Jones, D., Kemper, K. E., Holtz, Y., Nivard, M. J., Veul, L., Yengo, L., Zietsch, B. P., et al. (2018). Genetic Consequences of Social Stratification in Great Britain. *BioRxiv*.

Aber, L. J., Jones, S. M., Brown, J. L. Chaudry, N. and Samples, F. (1998). "Resolving conflict creatively: Evaluating the developmental effects of a school-based violence prevention program in neighborhood and classroom context." *Development and psychopathology* 10(2): 187-213.

Aboim, S. and Vasconcelos, P. (2009). Differential and cumulative effects of life course events in an intergenerational perspective: social trajectories of three-generation family lineages. *Swiss Journal of Sociology, 35,* pp.297-319.

Achenbach, T. M., and Edelbrock, C.S. (1978). The classification of child psychopathology: a review and analysis of empirical efforts. *Psychological bulletin, 85*(6), p.1275.

Achenbach, T.M., and Edelbrock, C.S. (1981). Behavioral problems and competencies reported by parents of normal and disturbed children aged four through sixteen. *Monographs of the society for research in child development*, pp.1-82.

Akers, R. L., Krohn, M. D., Lanza-Kaduce, L., and Radosevich, M. (1979). Social learning and deviant behavior: A specific test of a general theory. *American Sociological Review* (44): 636–655.

Algan, Y., Hémet, C., and Laitin, D. D. (2016). The social effects of ethnic diversity at the local level: A natural experiment with exogenous residential allocation. *Journal of Political Economy* (124,3): 696-733.

Ali, N., Ullah, A., and Shah, M. (2020) Linking academic performance of children with neighbourhood services: a gender based analysis. *Journal of Human Ecology* (69): 107-116.

Almlund, M., Duckworth, A. L., Heckman, J. and Kautz, T. (2011). Personality psychology and economics. In *Handbook of the Economics of Education*, 4: 1-181. Elsevier.

Alvarado, S. E. (2016). Delayed disadvantage: Neighbourhood context and child development. *Social Forces, 94*(4), pp.1847-1877.

Alvarado, S. E. (2018). The impact of childhood neighborhood disadvantage on adult joblessness and income. *Social Science Research, 70*, pp.1-17.

Alvarado, S. E. (2019). The indelible weight of place: Childhood neighborhood disadvantage, timing of exposure, and obesity across adulthood. *Health & Place, 58*, p.102159.

Alvarado, S. E., and Cooperstock, A. (2021). Context in continuity: The enduring legacy of neighborhood disadvantage across generations. *Research in Social Stratification and Mobility*, *74*, p.100620.

Arai, L. (2007). Peer and neighbourhood influences on teenage pregnancy and fertility: Qualitative findings from research in English communities. *Health & Place*, *13*(1), pp.87-98.

Ananat, E. O., Gassman-Pines, A., and Gibson-Davis, C. M. (2011). The effects of local employment losses on children's educational achievement. In G. J. Duncan & R. J. Murnane (Eds.), *Whither opportunity? Rising inequality, schools, and children's life chances* (pp. 299–314). New York: Russell Sage Foundation.

Ananat, E.O., and Gassman-Pines, A. (2021). Work schedule unpredictability: Daily occurrence and effects on working parents' well-being. *Journal of Marriage and Family*, *83*(1), pp.10-26.

Anderson, J. R. (1981). *Cognitive skills and their acquisition.* New York: Psychology Press.

Anderson, E. (1999). Code of the Street: Decency, Violence, and the Moral Life of the Inner City. New York: W.W. Norton.

Anger, S., and Schnitzlein, D.D. (2017). Cognitive skills, non-cognitive skills, and family background: evidence from sibling correlations. *Journal of Population Economics*, *30*, pp.591-620.

Armstrong, A. (2012). Belief in a just world and children's cognitive scores. *National Institute Economic Review*, *222*, pp.R7-R19.

Arold, B. W., Hufe, P., and Stoeckli, M. (2022). "Genetic Endowments, Educational Outcomes and the Mediating Influence of School Investments." *CESifo Working Paper No. 9841*.

Artigas, M. S., Wain, L. V., Miller, S., Kheirallah, A. K., Huffman, J E., Ntalla, I., Obeidat, N. S. M, Trochet, H., et al. (2015). Sixteen new lung function signals identified through 1000 Genomes Project reference panel imputation. *Nature communications* 6, no. 1: 8658.

Astone, N. M., and McLanahan., S. S. (1991). "Family structure, parental practices and high school completion." *American sociological review*: 309-320.

Atkinson, R. and Kintrea, K., (1998). *Reconnecting excluded communities: The neighbourhood impacts of owner occupation* (Vol. 61). Scottish Homes.

Attanasio, O., Blundell, R., Conti, G., and Mason, G., (2020). Inequality in socio-emotional skills: A cross-cohort comparison. *Journal of Public Economics*, *191*, p.104171.

Baier, T. and Lang., V. (2019). "The Social Stratification of Environmental and Genetic Influences on Education: New Evidence Using a Register-Based Twin Sample." *Sociological Science* 6:143–71.

Baier, T., and Van Winkle, Z. (2020). "Does Parental Separation Lower Genetic Influences on Children's School Performance?" *Journal of Marriage and Family* 83(3): 898–917.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review* (84,2): 191-215.

Barnes, J. C., and Jacobs, B. A. (2013). "Genetic risk for violent behavior and environmental exposure to disadvantage and violent crime: The case for gene–environment interaction." *Journal of Interpersonal Violence* 28(1): 92-120.

Barone, C. (2019). Towards an Education-based Meritocracy?. *ISA eSymposium for Sociology*, *9*(1).

Barone, C. and Van de Werfhorst, H. G. (2011). Education, cognitive skills and earnings in comparative perspective. *International Sociology*, *26*(4), pp.483-502.

Bauldry, S., Shanahan, M.J., Boardman, J.D., Miech, R.A., and Macmillan, R. (2012). A life course model of self-rated health through adolescence and young adulthood. *Social science & medicine*, *75*(7), pp.1311-1320.

Bellair, P. E. (1997). Social interaction and community crime: examining the importance of neighbor networks. *Criminology* 35(4):677–703

Bellair, P. E. (2000). Informal surveillance and street crime: a complex relationship. *Criminology* 38(1):137–67

Bernardi, F. (2014). "Compensatory advantage as a mechanism of educational inequality: A regression discontinuity based on month of birth." *Sociology of Education* 87(2): 74-88.

Bernardi, F. and Ballarino, G. (2016). "Education as the great equalizer: a theoretical framework." In *Education, occupation and social origin*, pp. 1-19. Edward Elgar Publishing, 2016.

Billings, S.B., Hoekstra, M. and Rotger, G.P. (2022). The Scale and Nature of Neighborhood Effects on Children: Evidence from a Danish Social Housing Experiment (No. w30764). *National Bureau of Economic Research*.

Bing, E. (1963). "Effects of Childrearing Practices on Development of Differential Cog- nitive Abilities." Child Development 34:631- 48

Bisin, A., and Verdier, T. (2011). The economics of cultural transmission and socialization. In *Handbook of social economics* (Vol. 1, pp. 339-416). North-Holland.

Black, S. E., and Devereux, P. J. (2010). *Recent Developments in Intergenerational Mobility*.

Blair, C., and Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child development*, *78*(2), pp.647-663.

Blanden, J. (2005). Intergenerational mobility and assortative mating in the UK. *Center for Economic Performance, unpublished manuscript*.

Blanden, J. and Machin, S. (2008). Up and down the generational income ladder in Britain: Past changes and future prospects. *National Institute Economic Review*, *205*, pp.101-116.

Blanden, J. and Machin, S. (2010). Intergenerational inequality in early years assessments. In *Children of the 21st century* (pp. 153-168). Policy Press.

Blau, P. M., and Dudley, D. O. (1967) *The American Occupational Structure.* New York: The Free Press.

Boardman, J. D., Domingue, B.W., Blalock, C. L., Haberstick, B. C., Mullan Harris, K., and McQueen, M. B. (2014). Is the gene-environment interaction paradigm relevant to genome-wide studies? The case of education and body mass index. *Demography* 51, no. 1: 119-139.

Borghans, L., Duckworth, A., Heckman, J., and Ter Weel, B. (2008). The economics and psychology of personality traits. *Journal of Human Resources* (43,4): 972-1059

Boudon, R. (1974). *Education, opportunity, and social inequality: Changing prospects in western society.*

Bourdieu, P. (1977). Cultural Reproduction and Social Reproduction, in *Power and Ideology in Education*: 487–511

Bourdieu, P., and Passeron, J.C. (1990). *Reproduction in education, society and culture* (Vol. 4). Sage.

Boughton, J. (2018). *Municipal dreams: The rise and fall of council housing*. Verso books.

Bourne, M., Bukodi, E., Betthäuser, B., and Goldthorpe, J. H. (2018). 'Persistence of the social': The role of cognitive ability in mediating the effects of social origins on educational attainment in Britain. *Research in Social Stratification and Mobility*, 58, 11-21

Boring, A. (2017). Gender biases in student evaluations of teaching. *Journal of public economics* (145): 27-41.

Bowles, S., and Gintis, H. (1976) *Schooling in capitalist America.* New York: Basic Book.

Bowles, S., Gintis, H., Groves M. O., (2005) (eds.) *Family Background and Economic Success.* New York: Russell Sage Foundation.

Brand, J.E., Zhou, X. and Xie, Y. (2023). Recent Developments in Causal Inference and Machine Learning. *Annual Review of Sociology*, *49*.

Brandén, M., Haandrikman, K., and Birkelund, G.E. (2022). Escaping one's disadvantage? Neighbourhoods, socioeconomic origin and children's adult life outcomes. *European Sociological Review*, p.jcac063.

Branigan, A. R., McCallum, K. J., and Freese, J. (2013). "Variation in the heritability of educational attainment: An international meta-analysis." *Social forces* 92(1): 109-140.

Breen, R. and Goldthorpe, J.H. (1999). Class inequality and meritocracy: a critique of Saunders and an alternative analysis1. *The British journal of sociology*, *50*(1), pp.1-27.

Briggs, X., Popkin, S., and Goering, J. (2010). *Moving to opportunity: The story of an American experiment to fight Ghetto poverty* . New York: Oxford University Press.

Briley, D. A., and Tucker-Drob, E. M. (2017). "Comparing the developmental genetics of cognition and personality over the life span". *Journal of Personality* 85(1): 51-64.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge: Harvard University Press.

Bronfenbrenner, U., and Ceci, S. J. (1994). "Nature-nuture reconceptualized in developmental perspective: A bioecological model." *Psychological review* 101(4): 568.

Bronfenbrenner, U., and Morris, P. A. (2006). The bioecological model of human development. In R. M. Lerner & W. E. Damon (Eds.), *Handbook of child psychology: Vol 1, theoretical models of human development* (pp. 793–828). West Sussex: Wiley.

Brooks-Gunn, J., Duncan G. J., and Kato, P. (1991). "Do Neighborhoods Influence Child and Adolescent Behavior?" Paper presented at a meeting of the Society for Research in Child Development, Seattle, WA

Brooks-Gunn, J., Duncan, G. J., Klebanov, P.K., and Sealand, N. (1993). Do neighborhoods influence child and adolescent development?. *American journal of sociology*, *99*(2), pp.353-395.

Brooks-Gunn, J., Klebanov, P.K., and Duncan, G.J. (1996). Ethnic differences in children's intelligence test scores: Role of economic deprivation, home environment, and maternal characteristics. *Child development*, *67*(2), pp.396-408.

Brown, E.D., and Ackerman, B.P. (2011). Contextual risk, maternal negative emotionality, and the negative emotion dysregulation of preschool children from economically disadvantaged families. *Early Education & Development*, *22*(6), pp.931-944.

Brooks-Gunn, J., Johnson, A. D., and Leventhal, T. (2010). Disorder, turbulence, and resources in children's homes and neighborhoods. In G. W. Evans & T. D. Wachs (Eds.), *Chaos and its influence on children's development: An ecological perspective* (pp. 155–170). American Psychological Association

Browning, C.R., Leventhal, T., and Brooks-Gunn, J. (2005). Sexual initiation in early adolescence: The nexus of parental and community control. *American Sociological Review* (70,5): 758-778.

Bubier, J.L., Drabick, D.A., and Breiner, T. (2009). Autonomic functioning moderates the relations between contextual factors and externalizing behaviors among inner-city children. *Journal of Family Psychology*, *23*(4), p.500.

Buchanan, A. and Ten Brinke, J. (2018). Children who may be at risk of emotional and behavioural problems. In *Parenting, schooling and children's behaviour* (pp. 34-52). Routledge.

Bukodi, E., Goldthorpe, J.H., Halpin, B., and Waller, L. (2016). Is education now class destiny? Class histories across three British birth cohorts. *European Sociological Review*, *32*(6), pp.835-849.

Bukodi, E., Bourne, M., Betthäuser, B., and Goldthorpe, J. (2019). Social origins, cognitive ability, educational attainment and social class position in Britain: A birth cohort and life-course perspective.

Burdick-Will, J., Ludwig, J., Raudenbush, S.W., Sampson, R.J., Sanbonmatsu, L., and Sharkey, P. (2011). Converging evidence for neighborhood effects on children's test scores: An experimental, quasi-experimental, and observational comparison. *Whither opportunity*, *2011*, pp.255-276.

Calarco, J.M. (2014). Coached for the classroom: Parents' cultural transmission and children's reproduction of educational inequalities. *American Sociological Review*, *79*(5), pp.1015-1037.

Callahan, K.L., Scaramella, L.V., Laird, R.D., and Sohr-Preston, S.L. (2011). Neighborhood disadvantage as a moderator of the association between harsh parenting and toddler-aged children's internalizing and externalizing problems. *Journal of Family Psychology*, *25*(1), p.68.

Cameron, S.V., and Heckman, J.J. (1993). The nonequivalence of high school equivalents. *Journal of labor economics*, *11*(1, Part 1), pp.1-47.

Carbonaro, W., Lauen, D.L., and Levy, B.L. (2023). Does Cumulative Exposure to High-Poverty Schools Widen Test-Score Inequality?. *Sociology of Education*, *96*(2), pp.81-103.

Carneiro, P., Crawford, C., and Goodman, A. (2007). The impact of early cognitive and non-cognitive skills on later outcomes. *CEE Discussion Papers 0092*, Centre for the Economics of Education, LSE.

Carter, J., Richards, M., Hotopf, M., and Hatch, S. (2019). The roles of non-cognitive and cognitive skills in the life course development of adult health inequalities. *Social Science & Medicine (*232): 190-198.

Casciano, R., and Massey, D.S. (2012). School context and educational outcomes: Results from a quasi-experimental study. *Urban Affairs Review*, *48*(2), pp.180-204.

Cavalli-Sforza, L.L., and Feldman, M.W. (1981). *Cultural transmission and evolution: A quantitative approach* (No. 16). Princeton University Press.

Ceci, S.J. (2006). Urie Bronfenbrenner (1917-2005). *American Psychologist*. pp.173-174

Chan, T.W., and Boliver, V. (2013). The grandparents effect in social mobility: Evidence from British birth cohort studies. *American Sociological Review*, *78*(4), pp.662-678.

Chase-Lansdale, P.L., Gordon, R.A., Brooks-Gunn, J., and Klebanov, P.K. (1997). Neighborhood and family influences on the intellectual and behavioral competence of preschool and early school-age children. *Neighborhood poverty*, *1*, pp.79-118.

Chauvin, P., and Parizot, I. (2009). Les inégalités sociales et territoriales de santé dans l'agglomération parisienne. Une analyse de la cohorte Sirs (2005).

Cheesman, R., Borgen, N. T., Lyngstad, T.H., Eilertsen,E.M., Ayorech, Z., Torvik, F.A, Andreassen, O.A., Zachrisson, H.D. et al. (2022). A population-wide gene-environment interaction study on how genes, schools, and residential areas shape achievement. n*pj Science of Learning* 7 : 29.

Chetty, R., Hendren, N., and Katz, L.F. (2016). The effects of exposure to better neighborhoods on children: New evidence from the Moving to Opportunity experiment. *American Economic Review* (106,4): 855-902.

Chetty, R., and Hendren, N. (2018). The impacts of neighborhoods on intergenerational mobility II: County-level estimates. *The Quarterly Journal of Economics*, *133*(3), pp.1163-1228.

Choi, S.W., and O'Reilly, P.F. (2019). "PRSice-2: Polygenic Risk Score software for biobank-scale data." *Gigascience* 8, no. 7.

Chyn, E. (2018). Moved to opportunity: The long-run effects of public housing demolition on children. *American Economic Review*, *108*(10), pp.3028-3056.

Clapham, D., and Kintrea, K. (1991). Housing Allocation and the Role of the Public Rented Sector. In: Donnison D, Maclennan D (eds). *The Housing Service of the Future*. Harlow: Longman, 53-71

Clampet-Lundquist, S. (2007). No more'bois ball: The effect of relocation from public housing on adolescents. *Journal of Adolescent Research*, *22*(3), pp.298-323.

Clampet-Lundquist, S., and Massey, D. S. (2008). Neighborhood effects on economic self-suffi ciency: A reconsideration of the moving to opportunity experiment. *American Journal of Sociology*, 114 (1), 107–143.

Clampet-Lundquist, S., Edin, K., Kling, J.R., and Duncan, G.J. (2011). Moving teenagers out of high-risk neighborhoods: How girls fare better than boys. *American Journal of Sociology* (116,4): 1154-89.

Clampet-Lundquist, S. (2013). Baltimore teens and work: Gendered opportunities in disadvantaged neighborhoods. *Journal of Adolescent Research*, 28(1): 122-149.

Clarke, P., Morenoff, J., Debbink, M., Golberstein, E., Elliott, M.R., and Lantz, P. M. (2014). Cumulative exposure to neighborhood context: consequences for health transitions over the adult life course. *Research on Aging*, 36, no. 1: 115-142.

Clegg., N. (2010). Deputy Prime Minister's speech on social mobility. Retrieved at: https://www.gov.uk/government/speeches/deputy-prime-ministers-speech-on-social-mobility

Coleman, J. S. (1988). Social capital in the creation of human capital. *American Journal of Sociology*, 94, S95-S120.

Conley, D., Domingue, B.W., Cesarini, D., Dawes, C., Rietveld, C.A., and Boardman, J. D. (2015)."Is the effect of parental education on offspring biased or moderated by genotype?." *Sociological science* 2: 82.

Cook, T.D., Campbell, D.T., and Shadish, W. (2002). *Experimental and quasi-experimental designs for generalized causal inference* (Vol. 1195). Boston, MA: Houghton Mifflin.

Connell, J.P., Clifford, E., and Crichlow, W. (1992). Why do urban students leave school? Neighborhood, family, and motivational influences. In *Conference on the Urban Underclass, University of Michigan, Ann Arbor, Michigan*.

Corcoran, M. (1995). Rags to rags: Poverty and mobility in the United States. *Annual review of sociology*, *21*(1), pp.237-267.

Crane, J. (1991). The epidemic theory of ghettos and neighborhood effects on dropping out and teenage childbearing. *American Journal of Sociology* (96,5): 1226-1259.

Croft, J. (2004). Positive choice, no choice or total rejection: The perennial problem of school catchments, housing and neighbourhoods. *Housing Studies* (19,6): 927-945.

Crowder, K. and South, S.J. (2011). Spatial and temporal dimensions of neighborhood effects on high school graduation. *Social science research*, *40*(1), pp.87-106.

Cunha, F., and Heckman, J. (2007). The technology of skill formation. *American economic review*, *97*(2), pp.31-47.

Curley, A.M. (2010). Neighborhood institutions, facilities, and public space: A missing link for Hope VI Residents' Development of Social Capital?. *Cityscape*, pp.33-63.

Dannefer, D. (2003). Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 58(6), S327-S337.

Davies, N.M., Hemani G., Timpson, N. J., Windmeijer, F., and Smith, G. D. (2015). The role of common genetic variation in educational attainment and income: evidence from the National Child Development Study. *Scientific Reports* 5(1): 1-12.

Delabroye, S. (2020). Learning from One Comm: Neighborhood Effects on Non-Cognitive Skills.

Department for Communities and Local Government. (2015). *English indices of deprivation 2015*. Retrieved from: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015

De Vuijst, E., van Ham, M., and Kleinhans, R. (2016). A life course approach to understanding neighbourhood effects.

De Vuijst, E. and van Ham, M. (2019). “Parents and Peers: Parental Neighbourhood-And School-Level Variation in Individual Neighbourhood Outcomes Later in Life.” *European Sociological Review* 35(1):49–64.

DiPrete, T.A., and Eirich, G.M. (2006). Cumulative advantage as a mechanism for inequality: A review of theoretical and empirical developments. *Annu. Rev. Sociol.*, *32*, pp.271-297.

Dickens, W.T. (2008). Cognitive Ability, in The New Palgrave Dictionary of Economics, S.N. Durlauf and L.E. Blume, Editors. Palgrave Macmillan: London.

Dietz, R. D. (2002). The estimation of neighborhood effects in the social sciences: An interdisciplinary approach. *Social Science Research* (31,4): 539–575.

Domingue, B.W., Belsky, D. W., Conley, D., Harris, K. M., Boardman, J. D. (2015). "Polygenic influence on educational attainment: New evidence from the National Longitudinal Study of Adolescent to Adult Health." *AERA open* 1(3): 2332858415599972.

Dominguez, S. and Watkins, C. (2003). Creating networks for survival and mobility: Social capital among African-American and Latin-American low-income mothers. *Social problems*, *50*(1), pp.111-135.

Dorling, D., and Rees, P. (2003). A nation still dividing: the British census and social polarisation 1971–2001. *Environment and Planning A*, *35*(7), pp.1287-1313.

Dorling, D., Rigby, J., Wheeler, B., Ballas, D., Thomas, B. and Fahmy, E. (2007) *Poverty, wealth and place in Britain, 1968 to 2005.* Bristol, UK: Policy Press.

Dowan, E., and Adelson, J. (1966). *The adolescent experience.* New York: Wiley.

DuBois, D.L., and Hirsch, B.J. (1990). School and neighborhood friendship patterns of Blacks and Whites in early adolescence. *Child development*, *61*(2), pp.524-536.

Duckworth, A.L., and Seligman, M.E. (2005). Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychological science*, *16*(12), pp.939-944.

Duckworth, A., and Gross, J. J. (2014). Self-control and grit: Related but separable determinants of success. *Current Directions in Psychological Science* (23,5): 319-325.

Duckworth, A.L., and Seligman, M.E. (2005). Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychological science*, *16*(12), pp.939-944.

Duncan, G., and Laren, D. (1990). "Neighborhood Correlates of Teen Births and Dropping Out: Preliminary Results from the PSID- Geocode File." Ann Arbor, MI: Survey Re- search Center, University of Michigan

Duncan, G.J. (1994). Families and neighbors as sources of disadvantage in the schooling decisions of white and black adolescents. *American journal of Education*, *103*(1), pp.20-53.

Duncan, G.J., Brooks-Gunn, J., and Klebanov, P.K. (1994). Economic deprivation and early childhood development. *Child development, 65*(2), pp.296-318.

Duncan, G.J., Boisjoly, J., and Mullan Harris, K. (2001). Sibling, peer, neighbor, and schoolmate correlations as indicators of the importance of context for adolescent development. *Demography, 38*, pp.437-447

Duncan, G.J., Morris, P.A., and Rodrigues, C. (2011). Does money really matter? Estimating impacts of family income on young children's achievement with data from random-assignment experiments. *Developmental psychology, 47*(5), p.1263.

Duncan, G.J., and Magnuson, K. (2011). The nature and impact of early achievement skills, attention skills, and behavior problems. *Whither opportunity*, pp.47-70.

Duncan, G.J. and Murnane, R.J. (2011). *Whiter Opportunity? Rising Inequality, Schools, and Children's Life Chances*. New York: Russel Sage Foundation.

Duneier, M. (1992). *Slim's Table: Race, Respectability, and Masculinity*. Chicago: Univ. Chicago Press

Dunn L.M., and Markwardt F.C. (1970). *Peabody Individual Achievement Test.* Circle Pines, MN: American Guidance Service.

Edgerton, J.D. and Roberts, L.W. (2014). Cultural capital or habitus? Bourdieu and beyond in the explanation of enduring educational inequality. *Theory and research in education*, *12*(2), pp.193-220.

Edin, K., Nelson, T.J., Paranal, R. (2001). *Fatherhood and incarceration as potential turning points in the criminal careers of unskilled men.* Evanston, IL: Institute for Policy Research, Northwestern University.

Elder, G. H., Jr., Johnson, M. K., and Crosnoe, R. (2003). The emergence and development of life course theory. In J. T. Mortimer & M. J. Shanahan (Eds.), *Handbook of the life course* (Vol. 1, pp. 3–19). New York: Kluwer Academic.

Elliott, D.S., Wilson, W.J., Huizinga, D., Sampson, R.J., Elliott, A., Rankin, B. (1996). The effects of neighborhood disadvantage on adolescent development. *J. Res. Crime Delinq.* 33:389–426

Engstrom, D.M. (1997). The economic determinants of ethnic segregation in Post-War Britain. *Nuffield Working Paper*

Entwisle, B. (2007). Putting people into place. *Demography, 44*, pp.687-703.

Entwisle, D.R., Alexander, K.L., and Olson, L.S. (1994). The gender gap in math: Its possible origins in neighborhood effects. *American Sociological Review* (59,6): 822-838.

Erola, J., Lehti, H., Baier, T., and Karhula, A. (2022). Socioeconomic Background and Gene–Environment Interplay in Social Stratification across the Early Life Course. *European Sociological Review 38*(1): 1-17.

Esping-Andersen, G., Cimentada, J. (2018). Ability and mobility: The relative influence of skills and social origin on social mobility. *Social Science Research* (75): 13-31.

Evensen, M., Lyngstad, T.H., Melkevik, O., and Mykletun, A. (2016). The role of internalizing and externalizing problems in adolescence for adult educational attainment: Evidence from sibling comparisons using data from the Young HUNT Study. *European Sociological Review*, *32*(5), pp.552-566.

European Commission. (2023). Social Segregation. Retrieved at: https://urban.jrc.ec.europa.eu/thefutureofcities/social-segregation#the-chapter

Fahmy, E., Gordon, D., Dorling, D., Rigby, J., and Wheeler, B. (2011). Poverty and place in Britain, 1968–99. *Environment and Planning A: Economy and Space.* SAGE Publications Ltd, 43(3), 594–617. Available from: https://doi.org/10.1068/a4388

Farkas, G. (2003). Cognitive skills and noncognitive traits and behaviors in stratification processes. *Annual Review of Sociology* (29,1): 541-562.

Farrington, C., Nagaoka, J., Johnson, D.W., Roderik, M., Allensworth, E., Keyes, T.S., et al. (2012) *Teaching Adolescents to Become Learners: The Role of Noncognitive Factors in Shaping School Performance. Consortium on Chicago School Research*.

Fauth, R.C., Leventhal, T., and Brooks-Gunn, J. (2007). Welcome to the neighborhood? Long-term impacts of moving to low-poverty neighborhoods on poor children's and adolescents' outcomes. *Journal of research on adolescence*, *17*(2), pp.249-284.

Feinstein, L., Lupton, R., Hammond, C., Mujtaba, T., Salter, E., and Sorhaindo, A. (2007). The public value of social housing: A longitudinal analysis of the relationship of housing and life chances. *Centre for Research on the Wider Benefits of Learning Institute of Education, University of London*.

Feldman, R. (2007). Parent-infant synchrony and the construction of shared timing; physiological precursors, developmental outcomes, and risk conditions. *J. Child Psychol.* Psychiatry Allied Discipl. 48, 329–354

Ferri, E. (1993). Life at 33: the fifth follow-up of the National Child Development Study. *(No Title)*.

Fiel, J.E. (2019). The transmission of multigenerational educational inequality. *Social Forces*, *97*(4), pp.1455-1486.

Figlio, D.N., Freese, J., Karbownik, K., and Jeffrey, R. (2017). "Socioeconomic status and genetic influences on cognitive development." *Proceedings of the National Academy of Sciences* 114(51): 13441-13446.

Fite, P.J., Vitulano, M., Wynn, P., Wimsatt, A., Gaertner, A., and Rathert, J. (2010). Influence of perceived neighborhood safety on proactive and reactive aggression. *Journal of Community Psychology*, *38*(6), pp.757-768.

Flouri, E., Midouhas, E., and Tzatzaki, K. (2015). Neighbourhood and own social housing and early problem behaviour trajectories. *Social psychiatry and psychiatric epidemiology*, *50*, pp.203-213.

Flouri, E., Midouhas, E., and Francesconi, M. (2020). Neighbourhood deprivation and child behaviour across childhood and adolescence. *Longitudinal and life course studies*, *11*(2), pp.203-227.

Fogelman, K. (1978). School attendance, attainment and behaviour. *British journal of Educational Psychology*, 48(2), 148-158.

Fombonne, E. (1989). The Child Behaviour Checklist and the Rutter Parental Questionnaire: a comparison between two screening instruments. *Psychological Medicine*, *19*(3), pp.777-785.

Forrester, R., and Kearns, A. (2001). 'Social Cohesion, Social Capital and the Neighbourhood', *Urban Studies,* 38 (12), pp. 2125–2143.

Friedrichs, J.R., Galster, G., and Musterd, S. (2003). Neighbourhood effects on social opportunities: the European and American research and policy context. *Housing studies*, *18*(6), pp.797-806.

Froiland, J.M., Powell, D.R., and Diamond, K.E. (2014). Relations among neighborhood social networks, home literacy environments, and children's expressive vocabulary in suburban at-risk families. *School Psychology International*, *35*(4), pp.429-444.

Fuller, E., Power, C., Shepherd, P., and Strachan, D. (2006). Technical report on the National Child Development Study biomedical survey 2002–2004. *National Centre for Social Research*.

Fumagalli, E., and Fumagalli, L. (2019). Neighbourhood ethnic composition and social participation of young people in england. *The Economic Journal* (129,622): 2459-2521.

Furstenberg, F.F., Cook, T.D., Eccles, J. and Elder Jr, G.H. (2000). *Managing to make it: Urban families and adolescent success*. University of Chicago Press.

Galster, G., Andersson, R., and Musterd, S. (2010). Who is affected by neighbourhood income mix? Gender, age, family, employment and income differences. *Urban Studies* (47,14): 2915-2944.

Galster, G.C. (2012). The Mechanism(s) of Neighbourhood Effects: Theory, Evidence, and Policy Implications. In: Van ham, M., Manley, D., Bailey, N., Simpson, L. & Maclennan, D. (eds.) *Neighbourhood Effects Research: New Perspectives.* Dordrecht: Springer Netherlands.

Galster, G.C., and Santiago, A.M. (2015). Evaluating the potential of a natural experiment to provide unbiased evidence of neighborhood effects on health. *Health Services and Outcomes Research Methodology*, *15*, pp.99-135.

Galster, G., Santiago, A.M., and Stack, L. (2016). Elementary school difficulties of low-income Latino and African American youth: The role of geographic context. *Journal of Urban Affairs*, *38*(4), pp.477-502.

Galster, G. and Sharkey, P. (2017). Spatial foundations of inequality: A conceptual model and empirical overview. *RSF: The Russell Sage Foundation Journal of the Social Sciences*, *3*(2), pp.1-33.

Galster, G., and Santiago, A.M. (2017). Do neighborhood effects on low-income minority children depend on their age? Evidence from a public housing natural experiment. *Housing Policy Debate*, *27*(4), pp.584-610.

Ganzeboom H.B.G., Donald, T. J, Wout, U. C. (1991). Comparative Intergenerational Stratification Research. Three Generations and Beyond. *Annual Review of Sociology*,17:277–302.

Garner, C.L., and Raudenbush, S.W. (1991). Neighborhood effects on educational attainment: A multilevel analysis. *Sociology of education*, pp.251-262.

Ghirardi, G. (2022). Is the effect of genes on education moderated by family's socioeconomic background? *ESSGN Conference*, May 18, Bologna, Italy.

Giangrande, E.J., Beam, C.R., Carroll, S., Matthews, L.J., Davis, D.W., Finkel,D., and Turkheimer, E. (2019). "Multivariate Analysis of the Scarr-Rowe Interaction across Middle Childhood and Early Adolescence." *Intelligence* 77(July):101400.

Gibbons, S. (2002). Neighbourhood effects on educational achievement CEE/Education and skills Discussion Paper. London: Centre for Economic Performance

Gibbons, S., Silva, O., and Weinhardt, F. (2013). Everybody needs good neighbours? Evidence from students' outcomes in England. *The Economic Journal (*123,571): 831-874.

Giofrè, D., Borella, E., and Mammarella, I.C. (2017). The relationship between intelligence, working memory, academic self-esteem, and academic achievement. *Journal of Cognitive psychology*, *29*(6), pp.731-747.

Goering, J., and Feins, J. D. (2003). *Choosing a better life? Evaluating the moving to opportunity social experiment* . Washington DC: Urban Institute Press.

Goldthorpe, J.H. (1980). Class mobility in modern Britain: a reply to Crompton. *Sociology*, *14*(1), pp.121-123.

Goldthorpe, J.H. and Jackson, M. (2007). Intergenerational class mobility in contemporary Britain: Political concerns and empirical findings 1. *The British journal of sociology*, *58*(4), pp.525-546.

Goldthorpe, J. and Jackson, M. (2008). "Education-based meritocracy: The barriers to its realization", in A. Lareau and D. Conley (eds) *Social Class. How Does It Work?*, Russell Sage Foundation Press, New York.

Goodenow, C. and Grady, K.E. (1993). The relationship of school belonging and friends' values to academic motivation among urban adolescent students. *The journal of experimental education*, *62*(1), pp.60-71.

Goodman, A. and Sianesi, B. (2005). Early education and children's outcomes: how long do the impacts last?. *Fiscal Studies*, *26*(4), pp.513-548.

Goodman, A., Joshi, H., Nasim, B. and Tyler, C. (2015). *Social and emotional skills in childhood and their long-term effects on adult life.* London: Institute of Education.

Goux, D., and Maurin, E. (2007) Close neighbours matter: neighbourhood effects on early performance at school. *Economic Journal* (117,523): 1193-215.

Graham, B.S. (2018). "Identifying and Estimating Neighborhood Effects." *Journal of Economic Literature* 56:450–500.

Grasby, K.L. (2019). "Little evidence that socioeconomic status modifies heritability of literacy and numeracy in Australia." *Child Development* 90(2): 623-637.

Greenhalgh, S., and Moss, J. (2009). *Principles for social housing reform*. Localis Research.

Green, Anne E. (1996). *Aspects of the changing geography of poverty and wealth.* In: Hills, J., (ed.) New inequalities : the changing distribution of income and wealth in the United Kingdom. Cambridge University Press, pp. 265-291. ISBN 9780521553261

Green, J., Nelson, G., Martin, A.J., and Marsh, H. (2006). The Causal Ordering of Self-Concept and Academic Motivation and Its Effect on Academic Achievement. *International Education Journal* (7,4): 534-546.

Greven, C.U., Harlaar, N., Kovas Y., Chamorro-Premuzic, T. and Plomin, R. (2009). "More than just IQ: School achievement is predicted by self-perceived abilities—But for genetic rather than environmental reasons." *Psychological Science* 20(6): 753-762.

Guo, G., and Stearns, E. (2002). "The social influences on the realization of genetic potential for intellectual development." *Social Forces* 80, 3 : 881-910

Guo, G., Roettger, M.E., and Cai, T. (2008). "The integration of genetic propensities into social-control models of delinquency and violence among male youths." *American Sociological Review* 73, no. 4 (2008): 543-568.

Guo, G., Li, Y., Wang, H., Cai, T., and Duncan, G. J. (2015). "Peer influence, genetic propensity, and binge drinking: A natural experiment and a replication." *American journal of sociology* 121(3): 914-954.

Gustafsson, B., Katz, K., and Österberg, T. (2017). Residential segregation from generation to generation: Intergenerational association in socio-spatial context among visible minorities and the majority population in metropolitan Sweden. *Population, Space and Place*, *23*(4), p.e2028.

Gutman, L., Schoon, I. (2013). The impact of non-cognitive skills on outcomes for young people. *Education Endowment Foundation* (59,22): 2019-2034.

Hamnett, C. (1986). "The changing socio-economic structure of London and the South East, 1961–1981". *Regional Studies*, 20 (5): pp. 391-406

Hanscombe, K.B., Trzaskowski, M.,. Haworth, C.M.A., Davis O.S.P., Dale, P.S., and Plomin, R. (2012). "Socioeconomic status (SES) and children's intelligence (IQ): In a UK-representative sample SES moderates the environmental, not genetic, effect on IQ." *PloS one* 7(2): e30320.

Harden, K.P., Domingue, B.W., Belsky, D.W., Boardman, J.D., Crosnoe, R., Malanchini, M., Nivard, M., Tucker-Drob, E.M., and Harris, K.M. (2020). "Genetic associations with mathematics tracking and persistence in secondary school." *NPJ science of learning* 5, no. 1: 1.

Harden, K.P. (2021). "*The Genetic Lottery: Why DNA Matters for Social Equality*." Princeton University Press, 2021.

Harding, D.J. (2003). Counterfactual models of neighborhood effects: The effect of neighborhood poverty on dropping out and teenage pregnancy. *American journal of Sociology*, *109*(3), pp.676-719.

Harding, D.J., Gennetian, L., Winship, C., Sanbonmatsu, L., and Kling, J.R. (2010). *Unpacking neighborhood influences on education outcomes: Setting the stage for future research* (No. w16055). National Bureau of Economic Research.

Hart, S. A., Soden, B., Johnson, W., Schatschneider, C., and Taylor, J. (2013). "Expanding the environment: gene× school-level SES interaction on reading comprehension." *Journal of Child Psychology and Psychiatry* 54, no. 10: 1047-1055.

Heckman, J.J., and Rubinstein, Y. (2001). The importance of noncognitive skills: Lessons from the GED testing program. *American economic review*, *91*(2), pp.145-149.

Heckman, J.J. "Skill formation and the economics of investing in disadvantaged children." *Science* 312, no. 5782 (2006): 1900-1902.

Hedman, L., van Ham, M., and Tammaru, T. (2017). Three generations of intergenerational transmission of neighbourhood context. *IZA Discussion Paper*

Hedman, L., Manley, D., van Ham, M. and Östh, J. (2015). Cumulative exposure to disadvantage and the intergenerational transmission of neighbourhood effects. *Journal of Economic Geography*, *15*(1), pp.195-215.

Hicks, A.L., Handcock, M.S., Sastry, N., and Pebley, A.R. (2018). Sequential neighborhood effects: The effect of long-term exposure to concentrated disadvantage on children's reading and math test scores. *Demography*, *55*(1), pp.1-31.

Howe, L.J., Nivard, M.G., Morris, T.T., Hansen, A.F., Rasheed, H., Cho, Y., Chittoor, G., Lind, P.A. et al. (2021a). Within-Sibship GWAS Improve Estimates of Direct Genetic Effects. *BioRxiv* 2021.03.05.433935.

Isungset, M. A., Conley, D., Zachrisson, H.D., Ystrøm, E., and Havdahl, a. (2021). Social and Genetic Effects on Educational Performance in Early Adolescence. *National Bureau of Economic Research* No. w28498.

Jackson, M. (2006). Personality traits and occupational attainment. *European Sociological Review*, *22*(2), pp.187-199.

Jackson, L., Langille, L., Lyons, R., Hughes, J., Martin, D., and Winstanley, V. (2009). Does moving from a high-poverty to lower-poverty neighborhood improve mental health? A realist review of 'Moving to Opportunity'. *Health & place*, *15*(4), pp.961-970.

Jackson, M.I. and Mare, R.D. (2007). Cross-sectional and longitudinal measurements of neighborhood experience and their effects on children. *Social science research*, *36*(2), pp.590-610.

Jacob, B.A. (2004). Public housing, housing vouchers, and student achievement: Evidence from public housing demolitions in Chicago. *American Economic Review*, *94*(1), pp.233-258.

Jæger, M.M., and Breen, R. (2016). "A dynamic model of cultural reproduction." *American Journal of Sociology* 121(4): 1079-1115.

Jeffers, B. J., Power, C., and Hertzman, C. (2002). Birth weight, childhood socioeconomic environment, and cognitive development in the 1958 British birth cohort study. *BMJ,* 325(7359), 305.

Jencks, C., and Mayer, S.E. (1990). The social consequences of growing up in a poor neighborhood. In: *Inner-city poverty in the United States,* National Academies Press, 111-186.

Jivraj, S., Norman, P., Nicholas, O., and Murray, E.T. (2019). Are there sensitive neighbourhood effect periods during the life course on midlife health and wellbeing? *Health & Place* (57): 147-156.

Johnson, J., Brown, M., Hancock, M. (2019). *National Child and Development Study: user guide to the response and deaths datasets I*. UCL (ed). Centre for Longitudinal Studies.

Joshi, H. (2014). Non-cognitive'skills: What are they and how can they be measured in the British cohort studies. *Centre for Longitudinal Studies*

Kauppinen, T.M. (2008). "Schools as Mediators of Neighbourhood Effects on Choice between Vocational and Academic Tracks of Secondary Education in Helsinki." *European Sociological Review* 24(3):379–91.

Kautz, T., and Zanoni, W. (2014). *Measuring and fostering non-cognitive skills in adolescence: Evidence from Chicago Public Schools and the OneGoal Program*. Chicago, IL: University of Chicago.

Kautz, T., Heckman, J.J., Diris, R., Ter Weel, B., and Borghans, L. (2014). Fostering and measuring skills: Improving cognitive and non-cognitive skills to promote lifetime success. *NBER Working Paper 20749*

Kawachi, I,. and Berkman, L.F. eds. (2003). *Neighborhoods and health*. Oxford University Press.

Keith, T.Z., and Reynolds, M.R. (2010). Cattell–Horn–Carroll abilities and cognitive tests: What we've learned from 20 years of research. *Psychology in the Schools*, 47(7): p. 635-650.

Keller, M.C. (2014). Gene × environment interaction studies have not properly controlled for potential confounders: the problem and the (simple) solution. *Biological psychiatry* 57 (1), 18-24.

Kent, G., Pitsia, V. (2018). Gender differences in cognitive development and school readiness. *Children's Research Digest* (5,3): 33-41.

Kessler, R.C., Duncan, G.J., Gennetian, L.A., Katz, L.F., Kling, J.R., Sampson, N.A., et al. (2014). Associations of housing mobility interventions for children in high-poverty neighborhoods with subsequent mental disorders during adolescence *Jama* (*311*,9): 937-947.

Kim, J.E., Hetherington, E.M., and Reiss, D. (1999). Associations among family relationships, antisocial peers, and adolescents' externalizing behaviors: Gender and family type differences. *Child Development* (*70*,5):1209-1230.

Kingston, P.W., Hubbard, R., Lapp, B., Schroeder, P., and Wilson, J. (2003). Why education matters. *Sociology of education*, pp.53-70.

Klassen, L., Eifler, E.F., Hufer, A., and Riemann, R. (2018). Why do people differ in their achievement motivation? A nuclear twin family study.*Primenjena psihologija* 11(4): 433-450.

Klein, M., and Kühhirt, M. (2021). Direct and indirect effects of grandparent education on grandchildren's cognitive development: the role of parental cognitive ability. *Sociological Science, 8*, pp.265-284.

Kleinepier, T., and van Ham, M. (2018). The temporal dynamics of neighborhood disadvantage in childhood and subsequent problem behavior in adolescence. *Journal of youth and adolescence,* 47: 1611-1628.

Klinenberg, E. (2002). *Heat Wave: A Social Autopsy of Disaster in Chicago*. Chicago: Univ. Chicago Press

Klinenberg, E. (2018). *Palaces for the people: How social infrastructure can help fight inequality, polarization, and the decline of civic life*. Crown.

Kling, J.R., Ludwig, J., and Katz, L.F. (2005). Neighborhood effects on crime for female and male youth: Evidence from a randomized housing voucher experiment. *The Quarterly Journal of Economics* 120(1): 87-130.

Kling, J.R., Jeffrey, B.L., and Lawrence, F.K. (2007). Experimental analysis of neighborhood effects. *Econometrica* (75,1): 83-119.

Kong, A., Thorleifsson, G., Frigge, M.L., Vilhjálmsson, B.J., Young, A.I., Thorgeirsson, T.E., Benonisdottir, S., Oddsson, A. et al. (2017). The Nature of Nurture : Effects of Parental Genotypes. *Science,* 359(6374), pp.424-428.

Krapohl, E., Rimfeld, K., Shakeshaft, N. G., Trzaskowski, M., McMillan, A., Pingault J.,

Asbury, K., Harlaar, N. et al. (2014). The high heritability of educational achievement reflects many genetically influenced traits, not just intelligence."*Proceedings of the national academy of sciences* 111(42): 15273-15278.

Kravitz-Wirtz, N. (2016). Cumulative effects of growing up in separate and unequal neighborhoods on racial disparities in self-rated health in early adulthood. *Journal of health and social behavior*, *57*(4), pp.453-470.

Kroneman, L., Loeber, R., and Hipwell, A.E. (2004). Is neighborhood context differently related to externalizing problems and delinquency for girls compared with boys? *Clinical Child and Family Psychology Review* (7,2): 109-122.

Kubrin, C.E., Weitzer, R. (2003). New directions in social disorganization theory. *Journal of Research in Crime and Delinquency* (40,4): 374-402.

Kunz, J., Page, M.E. and Solon, G. (2003). Are point-in-time measures of neighborhood characteristics useful proxies for children's long-run neighborhood environment?. *Economics Letters*, *79*(2), pp.231-237.

Kuh, D., Ben-Shlomo, Y., Lynch, J., Hallqvist, J., and Power, C. (2003). Life course epidemiology. *Journal of epidemiology and community health*, *57*(10), p.778.

Laidley, T., Vinneau, J., and Boardman, J. D. (2019). Individual and Social Genomic Contributions to Educational and Neighborhood Attainments: Geography, Selection, and Stratification in the United States. *Sociological Science* 6: 580-608. R

Lamont, M. and Lareau, A. (1988). Cultural capital: Allusions, gaps and glissandos in recent theoretical developments. *Sociological theory*, pp.153-168.

Lareau, A. (2003). *Unequal Childhoods: Class, Race, and Family Life*. University of California Press.

Lareau, A. (2011). *Unequal Childhoods: Class, Race, and Family Life*, 2nd ed. Berkeley: University of California Press.

Lauen, D.L., and Gaddis, S.M. (2013). Exposure to classroom poverty and test score achievement: Contextual effects or selection?. *American Journal of Sociology*, *118*(4), pp.943-979.

Lechuga-Pena, S., Becerra, D., Mitchell, F.M., Lopez, K., and Sangalang, C.C. (2019). Subsidized housing and low-income mother's school-based parent involvement: Findings from the fragile families and child wellbeing study wave five. *Child & Youth Care Forum* 48(3)

Lee, J.J., Wedow, R., Okbay, A., Kong, E., Maghzian, O., Zacher, M., Nguyen-Viet, T.A., Bowers, P. et al. (2018). Gene Discovery and Polygenic Prediction from a Genome-Wide Association Study of Educational Attainment in 1.1 Million Individuals. *Nature Genetics*.

Legewie, J., DiPrete, T.A. (2012). School context and the gender gap in educational achievement. *American Sociological Review* (77,3): 463-485.

Leventhal, T., Brooks-Gunn, J. (2000). The neighborhoods they live in: the effects of neighborhood residence on child and adolescent outcomes. *Psychological bulletin* (126,2): 309-337

Leventhal, T., Brooks-Gunn, J. (2003). Moving to Opportunity: An experimental study of neighborhood effects on mental health. *American Journal of Public Health* (93,9): 1576-1582.

Leventhal, T., Brooks-Gunn, J. (2004). A randomized study of neighborhood effects on low-income children's educational outcomes. *Developmental Psychology* (40,4): 488-507.

Leventhal, T., Xue, Y., and Brooks-Gunn, J. (2006). Immigrant differences in school-age children's verbal trajectories: A look at four racial/ethnic groups. *Child development*, *77*(5), pp.1359-1374.

Leventhal, T., and Dupéré, V. (2019). Neighborhood effects on children's development in experimental and nonexperimental research. *Annual Review of Developmental Psychology*, *1*, pp.149-176.

Levitt, S.D,. Venkatesh, S.A. (2000). An economic analysis of a drug-selling gang's finances. *Quarterly Journal of Economics*. 115:755–89

Levy, P., and Goldstein, H. (2014). *Tests in Education: a book of critical reviews*. Academic Press.

Levy, B.L. (2019). Heterogeneous Impacts of Concentrated Poverty During Adolescence on College Outcomes. *Social Forces* (98,1): 147-182.

Levy, B.L., Owens, A., and Sampson, R.J. (2019). "The varying effects of neighborhood disadvantage on college graduation: Moderating and mediating mechanisms." *Sociology of Education* 92, no. 3: 269-292.

Levy, B.L. (2021). Neighborhood effects, the life course, and educational outcomes: Four theoretical models of effect heterogeneity. *Space, place and educational settings*, pp.85-103.

Levy, B.L. (2022). Wealth, race, and place: How neighborhood (dis) advantage from emerging to middle adulthood affects wealth inequality and the racial wealth gap. *Demography*, *59*(1), pp.293-320.

Lin, M. (2020). "The social and genetic inheritance of educational attainment: Genes, parental education, and educational expansion." *Social science research* 86: 102387.

List, J.A., Momen, F., and Zenou, Y. (2020). The social side of early human capital formation: Using a field experiment to estimate the causal impact of neighborhoods. *National Bureau of Economic Research*, IZA Discussion Paper No. 13966.

Liu, H. (2018). "Social and Genetic Pathways in Multigenerational Transmission of Educational Attainment." *American Sociological Review* 83(2):278–304.

Liu, A. (2019). Can non-cognitive skills compensate for background disadvantage?--the moderation of non-cognitive skills on family socioeconomic status and achievement during early childhood and early adolescence. *Social science research*, *83*, p.102306.

Lleras, C. (2008). Do skills and behaviors in high school matter? The contribution of noncognitive factors in explaining differences in educational attainment and earnings. *Social science research*, *37*(3), pp.888-902.

Lloyd, C.D., Norman, P.D., and McLennan, D. (2023). Deprivation in England, 1971–2020. *Applied Spatial Analysis and Policy*, *16*(1), pp.461-484.

Lloyd, C.D., and Gleeson, J. (2018). Housing space in England at the neighbourhood-level, 1971 to 2017. *Applied Spatial Analysis and Policy*, *15*(4), pp.1433-1467.

Local Trust (2021). Left Behind Survey. Conducted by Suration. Available at: https://localtrust.org.uk/wp-content/uploads/2021/08/Left-Behind-2021-summary-document_Survation030821.pdf

Ludwig, J., Ladd, H.F., Duncan, G.J., Kling, J., and O'Regan, K.M. (2001). Urban poverty and educational outcomes. *Brookings-Wharton papers on urban affairs*, pp.147-201.

Ludwig, J., Sanbonmatsu, L., Gennetian, L., Adam, E., Duncan, G.J., Katz, L.F., Kessler, R.C., Kling, J.R., Lindau, S.T., Whitaker, R.C., and McDade, T.W. (2011). Neighborhoods, obesity, and diabetes—a randomized social experiment. *New England journal of medicine*, *365*(16), pp.1509-1519.

Ludwig, J., Duncan, G.J., Gennetian, L.A., Katz, L.F., Kessler, R.C., Kling, J.R., and Sanbonmatsu, L. (2013). Long-term neighborhood effects on low-income families: Evidence from Moving to Opportunity. *American economic review*, 103(3), 226-31.

Lupton, R. (2003). Poverty Street: The Dynamics of Neighbourhood Decline and Renewal. Bristol, UK: Policy Press

Lupton, R., Tunstall, R., Sigle-Rushton, W., Obolenskaya, P., Sabates, R., Meschi, E., et al. (2009) *Growing up in social housing in Britain: a profile of four generations from 1946 to the present day.* Tenant Services Authority, *London, UK.*

Lyons, M. (2003). Spatial segregation in seven cities: a longitudinal study of home ownership, 1971-91. *Housing studies*, *18*(3), pp.305-326.

Madigan, S., Oatley, H., Racine, N., Fearon, R. P., Schumacher, L., Akbari, E. et al. (2018). A meta-analysis of maternal prenatal depression and anxiety on child socioemotional development. *Journal of the American Academy of Child & Adolescent Psychiatry*, 57(9), 645-657.

Maggs, J.L., Patrick, M.E. and Feinstein, L. (2008). Childhood and adolescent predictors of alcohol use and problems in adolescence and adulthood in the National Child Development Study. *Addiction*, *103*, pp.7-22.

Manski, C.F. (1993). Identification of endogenous social effects: The reflection problem. *The Review of Economic Studies* (60,3): 531-542.

Mare, R.D. (2011). A multigenerational view of inequality. *Demography*, *48*(1), pp.1-23.

Martinez-Fernandez, C., Audirac, I., Fol, S. & Cunningham-Sabot, E. (2012) Shrinking cities: urban challenges of globalization. *International Journal of Urban and Regional Research*, 36(2), 213–225.

Martins, P.S. (2017). (How) do non-cognitive skills programs improve adolescent school achievement? Experimental evidence. *IZA Working Paper* n.10950

Marx, K. (1933). *Wage Labour and Capital.* New York: International Publishers.

Massey, D.S., and Denton, N.A. (1993). *American Apartheid: Segregation and the Making of the Underclass.* Cambridge, MA: Harvard University Press.

Mayer, S.E., and Jencks, C. (1989). Growing up in poor neighborhoods: How much does it matter?. *Science*, *243*(4897), pp.1441-1445.

McAvay, H. (2018). How durable are ethnoracial segregation and spatial disadvantage? Intergenerational contextual mobility in France. *Demography*, *55*(4), pp.1507-1545.

McAvay, H. (2020). Socioeconomic status and long-term exposure to disadvantaged neighbourhoods in France. *Urban Studies*, *57*(13), pp.2663-2680.

McBride Murry, V., Berkel, C., Gaylord-Harden, N.K., Copeland-Linder, N., and Nation, M. (2011). Neighborhood poverty and adolescent development. *Journal of Research on adolescence* 21(1): 114-128.

McCrae, R.R., and Costa, P.T. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of personality and social psychology*, *52*(1), p.81.

McCulloch A., and Joshi, H. E. (2001). Neighbourhood and family influences on the cognitive ability of children in the British National Child Development Study. *Social Science & Medicine* 53(5): 579-591.

McCulloch, A. (2006). Variation in children's cognitive and behavioural adjustment between different types of place in the British National Child Development Study. *Social science & medicine*, *62*(8), pp.1865-1879.

McGue, M., Willoughby, E.A., Rustichini, A., Johnson, W., Iacono, W.G., and Lee, J.J. (2020). The contribution of cognitive and noncognitive skills to intergenerational social mobility. *Psychological Science*, *31*(7), pp.835-847.

McLachlan, G., and Norman, P. (2021). Analysing socio-economic change using a time comparable geodemographic classification: England and Wales, 1991–2011. Applied Spatial Analysis and Policy, 14(1), 89–111

McLeod, J.D., and Fettes, D.L. (2007).Trajectories of failure: The educational careers of children with mental health problems. *American Journal of Sociology* (113,3): 653-701.

Mendenhall, R., DeLuca, S. and Duncan, G. (2006). Neighborhood resources, racial segregation, and economic mobility: Results from the Gautreaux program. *Social Science Research*, *35*(4), pp.892-923.

Meyers, J.L., Cerda, M., Galea, S., Keyes, K.T., Aiello, A., Uddin, M., Wildman, D., and Koenen, K. C. (2013). "Interaction between polygenic risk for cigarette use and environmental exposures in the Detroit neighborhood health study." *Translational psychiatry* 3.8: e290-e290.

Michael, R. (2003). Children's cognitive skill development in Britain and the United States. *International Journal of Behavioral Development*, *27*(5), pp.396-408.

Mikhail, G., Dubrov, D., Kosaretsky, S., and Grigoryev, D. (2021). The Strategies of Parental Involvement in Adolescents' Education and Extracurricular Activities. *Journal of Youth and Adolescence* 50(5): 906-920.

Mijs, J.J., and Nieuwenhuis, J. (2022). Adolescents' future in the balance of family, school, and the neighborhood: A multidimensional application of two theoretical perspectives. *Social Science Quarterly*, *103*(3), pp.534-549.

Mills, M.C., Barban, N., and Tropf, F.C. (2020). *An Introduction to Applied Statistical Genetics Analysis*. Cambridge, MA: The MIT Press.

Mills, M.C. and Tropf, F.C. (2020). Sociology, Genetics, and the Coming of Age of Sociogenomics. *Annual Review of Sociology* 46(1):553–81.

Minh, A., Muhajarine, N., Janus, M., Brownell, M., and Guhn, M. (2017). A review of neighborhood effects and early child development: How, where, and for whom, do neighborhoods matter?. *Health & place*, *46*, pp.155-174.

Moffitt, T. (1993). Adolescence-limited and life-course-persistent antisocial-behaviour – A developmental taxonomy. *Psychological Review* (100,4): 674–701.

Morgan S.L., Grusky D.B., Fields Gary S., editors. (2006) *Studies in Social Inequality. Frontiers of Research in Sociology and Economics.* Stanford: Stanford University Press.

Mostafavi, H., Harpak, A., Conley, D., Pritchard, J.K., and Przeworski, M. (2019). Variable Prediction Accuracy of Polygenic Scores within an Ancestry Group. *BioRxiv*.

Moulton, V., McElroy, E., Richards, M., Fitzsimons, E., Northstone, K., Conti, G., Ploubidis, G.B., Sullivan, A., and O'Neill, D. (2020*). A guide to the cognitive measures in five British birth cohort studies.* London, UK: CLOSER.

Mulrenan, G. (2019). The long history of social housing segregation in Britain. Available at: https://blogs.lse.ac.uk/politicsandpolicy/social-housing-segregation/

Murray, E.T., Nicholas, O., Norman, P., and Jivraj, S. (2021). Life Course neighborhood deprivation effects on body mass index: Quantifying the importance of selective migration. *International Journal of Environmental Research and Public Health* (18,16): 83-99.

Murphy, R.. and Weinhardt, F. (2020). Top of the class: The importance of ordinal rank. *The Review of Economic Studies*, *87*(6), pp.2777-2826.

Musterd, S., Galster, G., and Andersson, R. (2012). Temporal dimensions and measurement of neighbourhood effects. *Environment and Planning A*, *44*(3), pp.605-627.

Nash, R. (2001). Class, 'ability' and attainment: A problem for the sociology of education. *British Journal of Sociology of Education*, *22*(2), pp.189-202.

Newman, K.S., and Massengill, R.P. (2006). The texture of hardship: Qualitative sociology of poverty, 1995–2005. *Annual Revue of Sociology.*, *32*, pp.423-446.

Nghiem, H.S., Nguyen, H.T., Khanam, R., and Connelly, L.B. (2015) "Does school type affect cognitive and non-cognitive development in children? Evidence from Australian primary schools." *Labour Economics* 33: 55-65.

Nguyen, Q.C., Rehkopf, D.H., Schmidt, N.M., and Osypuk, T.L. (2016). Heterogeneous effects of housing vouchers on the mental health of US adolescents. *American journal of public health*, 106(4): 755-762.

Nieuwenhuis, J., Hooimeijer, P., and Meeus, W. (2015). Neighbourhood effects on educational attainment of adolescents, buffered by personality and educational commitment. *Social science research*, *50*, pp.100-109.

Nieuwenhuis, J. and Hooimeijer, P. (2016). The association between neighbourhoods and educational achievement, a systematic review and meta-analysis. *Journal of Housing and the Built Environment*, *31*, pp.321-347.

Nieuwenhuis, J., van Ham, M., Rongqin, Y., Branje, S., Meeus, W., and Hooimeijer, P. (2017). Being poorer than the rest of the neighborhood: relative deprivation and problem behavior of youth. *Journal of Youth and Adolescence* (46,9): 1891-1904.

Nieuwenhuis, J., Kleinepier, T., and van Ham, M., (2021). The role of exposure to neighborhood and school poverty in understanding educational attainment. *Journal of Youth and Adolescence*, *50*, pp.872-892.

Noble, M., and Smith, G. (1996). Two nations? Changing patterns of income and wealth in two contrasting areas. In: Hills, J., (ed.) *New inequalities : the changing distribution of income and wealth in the United Kingdom*. Cambridge University Press, pp. 265-291. ISBN 9780521553261

Novembre, J., Johnson, T., Bryc, K., Kutalik, Z., Boyko, A.R., Auton, A., Indap, A., King, K.S. et al. (2008). Genes Mirror Geography within Europe. *Nature* 456(7218):98–101.

Oakes, J.M., Andrade, K.E., Biyoow, I.M., and Cowan, L.T. (2015). Twenty years of neighborhood effect research: an assessment. *Current epidemiology reports*, *2*, pp.80-87.

Oberti, M. and Savina, Y. (2019). Urban and school segregation in Paris: The complexity of contextual effects on school achievement: The case of middle schools in the Paris metropolitan area. *Urban studies*, *56*(15), pp.3117-3142.

Oberwittler, D. (2007). The effects of neighbourhood poverty on adolescent problem behaviours: A multi-level analysis differentiated by gender and ethnicity. *Housing Studies*, *22*(5), pp.781-803.

Odgers, C.L., Moffitt, T.E., Tach, L.M., Sampson, R.J., Taylor, A., Matthews, C.L., and Caspi, A. (2009). The protective effects of neighborhood collective efficacy on British children growing up in deprivation: a developmental analysis. *Developmental psychology*, *45*(4), p.942.

Okbay, A., Wu, Y., Wang, N., Jayashankar, H., Bennett, M., Nehzati, S.M., Sidorenko, J., Kweon, H. et al. (2022). Polygenic Prediction of Educational Attainment within and between Families from Genome-Wide Association Analyses in 3 Million Individuals. *Nature Genetics* 54(April).

O'Rand, A.M. (1996). The precious and the precocious: Understanding cumulative disadvantage and cumulative advantage over the life course. *The Gerontologist*, *36*(2), pp.230-238.

Orr, L., Feins, J. D., Jacob, R., Beecroft, E., Sanbonmatsu, L., Katz, L. F., Liebman, J. B., and Kling, J. R. (2003). *Moving to opportunity interim impacts evaluation* . Washington DC: U.S. Department of Housing and Urban Development.

Overman, H. (2022) 'Levelling Up'; the government's plans aren't enough to promote economic growth and tackle inequality. LSE British Politics and Society Blog. Available at: https://blogs.lse.ac.uk/politicsandpolicy/levelling-up-the-governments-plans-arent-enough-to-promote-economic-growth-and-tackle-inequality/

Pacione, M. (1997). "The geography of educational disadvantage in Glasgow." *Applied Geography* 17(3): 169-192.

Parcel, T.L., and Campbell, L.A. (2017). Can the welfare state replace parents? Children's cognition in the United States and Great Britain. *Social Science Research*, *64*, pp.79-95.

Parrish, T., Matsumoto, C.S., and Fowler, W.J. (1995). *Disparities in public school district spending, 1989-90: A multivariate, student-weighted analysis, adjusted for differences in geographic cost of living and student need.* US Department of Education, Office of Educational Research and Improvement, National Center for Education Statistics.

Pasman, J.A., Verweij, K.J.H, Abdellaoui, A., Hottenga, J.J., Fedko, I.O., Willemsen,G., Boomsma, D.I., and Vink, J.M. (2020)."Substance use: interplay between polygenic risk and neighborhood environment." *Drug and alcohol dependence* 20: 107948.

Patacchini, E., Zenou, Y. (2011). Neighborhood effects and parental involvement in the intergenerational transmission of education. *Journal of Regional Science* (51,5): 987-1013.

Patias, N., Rowe, F., and Arribas-Bel, D. (2022). Trajectories of neighbourhood inequality in Britain: Unpacking inter-regional socioeconomic imbalances, 1971− 2011. *The Geographical Journal*, *188*(2), pp.150-165.

Pawson, H., and Kintrea, K. (2002). Part of the problem or part of the solution? Social housing allocation policies and social exclusion in Britain. *Journal of Social Policy* (31): 643–667.

Pattillo-McCoy, M. (1999). *Black Picket Fences: Privilege and Peril Among the Black Middle Class.* Chicago: Univ. Chicago Press

Peach, C. (1992). Urban Concentration and Segregation in Europe since 1945, *Ethnic Minorities and Industrial Change in Europe and North America*, pp. 124-125

Pebley, A.R., and Sastry, N. (2003). Neighborhoods, Poverty, and Children's Well-Being: A Review. *Rand*.

Perry, D.G., Pauletti, R.E. (2011). Gender and adolescent development. *Journal of Research on Adolescence* (21(1): 61-74.

Pfeffer, F.T. (2014). Multigenerational approaches to social mobility. A multifaceted research agenda. *Research in social stratification and mobility*, *35*, p.1.

Plomin, R., and Deary, I.J. (2015). Genetics and intelligence differences: five special findings. *Molecular psychiatry* 20(1): 98-108.

Plotnick, R.D., and Hoffman, S.D. (1999). The effect of neighborhood characteristics on young adult outcomes: Alternative estimates. *Social Science Quarterly*, pp.1-18.

Plybon, L.E., Lorraine, E., Butler, D., Belgrave, F.Z., and Allison, K.W. (2003). Examining the link between neighborhood cohesion and school outcomes: The role of support coping among African American adolescent girls. *Journal of Black Psychology* (29,4): 393-407

Polderman, T.J., Benyamin, B., De Leeuw, C.A., Sullivan, P.F., van Bochoven, A., Visscher, P.M. and Posthuma, D. 2015. Meta-analysis of the heritability of human traits based on fifty years of twin studies. *Nature genetics* 47(7): 702-709.

Popkin, S.J., Katz, B., Cunningham, M. K., Brown, K., Gustafson, J., and Turner, M. A. (2004). A decade of HOPE VI: Research findings and policy challenges. The Urban Institute.

Popkin, S.J., Leventhal, T., and Weismann, G. (2008). *Girls in the 'hood: The importance of feeling safe.* Washington, DC: The Urban Institute. Retrieved at: https://webarchive.urban.org/UploadedPDF/411002_HOPEVI.pdf

Power, C., Li, L. and Hertzman, C. (2008). Cognitive development and cortisol patterns in mid-life: findings from a British birth cohort. *Psychoneuroendocrinology*, *33*(4), pp.530-539.

Power, C., and Elliott, J. (2005). Cohort profile: 1958 British birth cohort (National Child Development Study). *International Journal of Epidemiology*, 35, 34–41.

Propper, C., Burgess, S., Bolster, A., Leckie, G., Jones, J., and Johnston, R. (2007). The impact of neighbourhood on the income and mental health of British social renters. *Urban Studies* (44,2): 393-415.

Public First. (2021). Levelling Up Poll. Accessed at: https://www.publicfirst.co.uk/wp-content/uploads/2021/11/Levelling_Up_Poll.pdf

Quane, J., Joshi, P.K., Dordick, G., and Henrici, J. (2002). Neighborhood organizations and the people who use them: a spatial consideration of welfare reform. Presented at *Ann. Meet. Am. Sociol. Assoc.*, Aug. 16–19, Chicago

Quillian, L. (2003). How long are exposures to poor neighborhoods? The long-term dynamics of entry and exit from poor neighborhoods. *Population research and policy review*, *22*, pp.221-249.

Raudenbush, S.W., and Sampson, R.J. (1999). Ecometrics: toward a science of assessing ecological settings, with application to the systematic social observation of neighborhoods. *Sociological methodology*, *29*(1), pp.1-41.

Regan, S., and Patrick, R. (2001). *Squeezed out: choice and affordability in housing.* London: Institute for Public Policy Research.

Rendón, M.G. (2014). Drop out and "disconnected" young adults: Examining the impact of neighborhood and school contexts. *The Urban Review*, *46*, pp.169-196.

Rietveld, C.A., Medland, S.E., Derringer, J., Yang, J., Esko, T., Martin, N.W., Westra, H., Shakhbazov, K., Abdellaoui, A., and Agrawal, A. 2013. GWAS of 126,559 Individuals Identifies Genetic Variants Associated with Educational Attainment. *Science* 340(6139):1467–71.

Riina, E.M., Martin, A., and Brooks-Gunn, J. (2014). Parent-to-child physical aggression, neighborhood cohesion, and development of children's internalizing and externalizing. *Journal of Applied Developmental Psychology*, *35*(6), pp.468-477.

Ritz, B.R., Chatterjee, N., Garcia-Closas, M., Gauderman, W.J., Pierce, B.L., Kraft, P., Tanner, C.M., Mechanic, L.E., and McAllister, K. (2017). Lessons learned from past gene-environment interaction successes. *American journal of epidemiology* 186, 7: 778-786.

Roberts, B.W., Kuncel, N.R., Shiner, R., Caspi, A., and Goldberg, L.R. (2007). The power of personality: The comparative validity of personality traits, socioeconomic status, and cognitive ability for predicting important life outcomes. *Perspectives on Psychological science*, 2(4), pp.313-345.

Robins, J. (1986). A new approach to causal inference in mortality studies with a sustained exposure period—application to control of the healthy worker survivor effect. *Mathematical modelling*, *7*(9-12), 1393-1512.

Robins, J.M. (2000). Marginal structural models versus structural nested models as tools for causal inference. In *Statistical models in epidemiology, the environment, and clinical trials* (pp. 95-133). New York, NY: Springer New York.

Robinson, M.R., English, G., Moser, G., Lloyd-Jones, L.R., Triplett, M.A., Zhu, Z., Nolte, I.M., Van Vliet-Ostaptchouk, J.V., Snieder, H., et al. 2017. Genotype-Covariate Interaction Effects and the Heritability of Adult Body Mass Index. *Nature Genetics* 49:1174–1181.

Rokven, J.J., de Boer, G., Tolsma, J., and Ruiter, S. (2017). How friends' involvement in crime affects the risk of offending and victimization. *European journal of criminology*, *14*(6), pp.697-719.

Rosenbaum, J. E. (1995). Changing the geography of opportunity by expanding residential choice: Lessons from the Gautreaux program. *Housing Policy Debate,* 6, 231–269.

Rosenbaum, J.E., and DeLuca, S. (2000). Is Housing Mobility the Key to Welfare Reform? Lessons from Chicago's Gautreaux Program. *Brookings Institution Center on Urban and Metropolitan Policy Survey Series*, Washington, DC.

Rosenfeld L., Rima, R., Ginger L. C., Emmons K., Dolores, A. 2010. "Are Neighborhood-Level Characteristics Associated with Indoor Allergens in the Household?" *Journal of Asthma* 47:66–75.

Rowe, D.C., Jacobson, K.C., and Van Den Oord, E.J.C.G. (1999). "Genetic and Environmental Influences on Vocabulary IQ: Parental Education Level as Moderator." *Child Development* 70(5):1151–62.

Rowthorn, B. (1986). De-industrialisation in Britain. *The Geography of De-industrialisation*, pp.1-30.

Rubinowitz, L., and Rosenbaum, J.E. (2000). *Crossing the Class and Color Lines: Low-Income Black Families in White Suburbs*. Chicago: University of Chicago Press.

Ruks, M. (2022). Investigating the mechanisms of G×SES interactions for education. *Research in Social Stratification and Mobility* 81: 100730.

Runciman, W.G. (1966). Relative Deprivation and Social Justice. Berkeley, CA: University of California Press.

Rutter, M. (1967). A children's behaviour questionnaire for completion by teachers: preliminary findings. *Journal of child psychology and psychiatry*, 8(1), pp.1-11.

Ryabov, I. (2020). Intergenerational transmission of socio-economic status: The role of neighborhood effects. *Journal of Adolescence* (80): 84-97.

Safi, M. (2009). La dimension spatiale de l'intégration: évolution de la ségrégation des populations immigrées en France entre 1968 et 1999. *Revue française de sociologie*, *50*(3), pp.521-552.

Sampson, R.J., Groves, W. (1989). Community Structure and Crime: Testing Social-Disorganization Theory. *American Journal of Sociology*(94): 774-802.

Sampson, R.J. and Raudenbush, S.W. (1999). Systematic Social Observation of Public Spaces:

A New Look at Disorder in Urban Neighborhoods. *American Journal of Sociology* 105(3):603–51.

Sampson, R.J., Morenoff, J. and Gannon-Rowley, T. (2002). Assessing "neighborhood effects": Social processes and new directions in research. *Annual Review of Sociology (*28,1): 443-78.

Sampson, R.J., Sharkey, P., and Raudenbush, S.W. (2008). Durable effects of concentrated disadvantage on verbal ability among African-American children. *Proceedings of the National Academy of Sciences*, *105*(3), pp.845-852.

Sampson, R.J. (2012). *Great American city: Chicago and the enduring neighborhood effect.*. Chicago: University of Chicago Press

Sampson, R.J., and Winter, A.S. (2016). The racial ecology of lead poisoning: Toxic inequality in Chicago neighborhoods, 1995-2013. *Du Bois Review: Social Science Research on Race*, *13*(2), pp.261-283.

Sampson, R.J. (2022). Legacies of inequality, legacy lead exposures, and improving population well-being. *Proceedings of the National Academy of Sciences*, *119*(14), p.e2202401119.

Sanbonmatsu, L., Kling, J.R., Duncan, G.J., and Brooks-Gunn, J. (2006). Neighborhoods and academic achievement: Results from the Moving to Opportunity experiment. *Journal of Human resources*, *41*(4), pp.649-691.

Sanbonmatsu, L., Katz, L.F., Ludwig, J., Gennetian, L.A., Duncan, G.J., Kessler, R.C., Adam, E.K., McDade, T., and Lindau, S.T. (2011). Moving to opportunity for fair housing demonstration program. Final Impacts Evaluation: US Department of Housing and Urban Development.

Sari, F. (2012). Analysis of neighbourhood effects and work behaviour: Evidence from Paris. *Housing Studies* (27,1): 45-76.

Sastry, N., and Pebley, A.R. (2010). Family and neighborhood sources of socioeconomic inequality in children's achievement. *Demography*, *47*, pp.777-800.

Sattler, L.J., Thomas, K.A., Vaughn, M.J., Almeida, J., White, L.A., and Waldman, M.R. (2019). "Community matters: GxE interactions predicting childhood aggression and violent behavior." *Journal of criminal justice* 61: 58-71.

Saunders, P. (1996). *Unequal but fair. A study of class barriers in Britain*. Great Britain: Civitas.

Saunders, P. (1997). Social mobility in Britain: an empirical evaluation of two competing explanations. *Sociology*, *31*(2), pp.261-288.

Saunders, P. (2006) *Social class and stratification*. Routledge.

Savage, M., and Egerton, M. (1997). Social mobility, individual ability and the inheritance of class inequality. *Sociology*, *31*(4), pp.645-672.

Scarr-Salapatek, S. (1971). Race, Social Class, and IQ: Population differences in heritability of IQ scores were found for racial and social class groups. *Science* 174.4016: 1285-1295.

Schlossberg, N.K. and Goodman, J. (1972). A woman's place: Children's sex stereotyping of occupations. *Vocational Guidance Quarterly*, *20*(4), pp.266-270.

Schoon, I. (2008). A transgenerational model of status attainment: The potential mediating role of school motivation and education. *National Institute Economic Review*, *205*, pp.72-82.

Schwitzer, E.R., and Lister, J. (2021). The public favours meritocracy when it comes to levelling up and university admissions. Retrieved from https://wonkhe.com/blogs/the-public-favours-meritocracy-when-it-comes-to-levelling-up-and-university-admissions/

Scott, G. (2004). "It's a sucker's outfit": how urban gangs enable and impede the reintegration of ex-convicts. *Ethnography* 5:107– 40

Selzam, S., Krapohl, E., Von Stumm, S., O'Reilly, P.F., Rimfeld, K., Kovas, Y., Dale, P. S., Lee, J.J., and Plomin, R. (2017). Predicting educational achievement from DNA. *Molecular psychiatry* 22, no. 2: 267-272.

Sewell, W.H., Haller, A.O., and Portes, A. (1969). The educational and early occupational attainment process. American Sociological Review, Vol. 34, No. 1, pp.82-89

Shanahan, M.J., and Hofer, S.M. (2005). Social context in gene–environment interactions: Retrospect and prospect. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 60.Special_Issue_1: 65-76.

Sharkey, P. (2008). The intergenerational transmission of context. *American Journal of Sociology*, *113*(4), pp.931-969.

Sharkey, P., and Elwert, F. (2010). Multigenerational Neighborhood Effects on Parental Educational Plans, and Child Health. Delivered at the "SES and Health across Generations and over the Life Course" Conference, Ann Arbor, MI, September 23-24, 2010

Sharkey, P. and Elwert, F. (2011). The legacy of disadvantage: Multigenerational neighborhood effects on cognitive ability. *American journal of sociology*, *116*(6), pp.1934-1981.

Sharkey, P. (2013). *Stuck in place: Urban neighborhoods and the end of progress toward racial equality*. University of Chicago Press.

Sharkey, P., and Faber, J. (2014). Where, When, Why, and For Whom Do Residential Contexts Matter? Moving Away From the Dichotomous Understanding of Neighborhood Effects. *Annual Review of Sociology (*40): 559-579.

Shipton, E., and Bermingham, R. (2018). Developing non-academic skills. *POSTNote No. 583*. Retrieved from the House of Parliament.

Silverwood, R., Narayanan, M., Dodgeon, B., and Ploubidis, G. (2021). Handling missing data in the National Child Development Study: User guide (Version 2). London: UCL Centre for Longitudinal Studies.

Simpson, M. (1980). The sociology of cognitive development. *Annual Review of Sociology*, *6*(1), pp.287-313.

Singh, G.K. and Ghandour, R.M. (2012). Impact of neighborhood social conditions and household socioeconomic status on behavioral problems among US children. *Maternal and child health journal*, *16*, pp.158-169.

Sirin, S.R. (2005). Socioeconomic status and academic achievement: A meta-analytic review of research. *Review of Educational Research* (75,3): 417-453.

Sykes, B. and Musterd, S. (2011). Examining Neighbourhood and School Effects Simultaneously: What Does the Dutch Evidence Show? *Urban Studies* 48(7):1307–31.

Slutske, W.S., Deutsch, A.R., and Piasecki, T.M. (2019). Neighborhood alcohol outlet density and genetic influences on alcohol use: Evidence for gene–environment interaction. *Psychological medicine* 49(3): 474-482.

Small, M.L. (2004). *Villa Victoria: The transformation of social capital in a Boston barrio*. University of Chicago Press.

Small, M.L. (2002). Culture, cohorts, and social organization theory: Understanding local participation in a Latino housing project. *American Journal of Sociology*, *108*(1), pp.1-54.

Small M.L., and Newman, K. (2001). Urban poverty after the truly disadvantaged: The rediscovery of the family, the neighborhood, and culture. *Annual Review of Sociology* (27,1): 23-45.

Small M.L., and Feldman, J. (2012). Ethnographic Evidence, Heterogeneity, and Neighbourhood Effects after Moving to Opportunity. In: *Neighbourhood Effects Research: New Perspectives.* Dordrecht: Springer, 57–77.

Solon, G. (1999). Intergenerational Mobility in the Labor Market. In: Ashenfelter O, Card D, editors. *Handbook of Labor Economics.* Oxford: Elsevier; pp. 1761–1800.

South, S.J., Huang, Y., Spring, A., and Crowder, K. (2016). Neighborhood attainment over the adult life course. *American Sociological Review*, *81*(6), pp.1276-1304.

Spencer, M.B. (1992). "Neighborhood Features, Self-Esteem and Achievement Orientation." Paper presented at a meeting of the *Society for Research on Adolescence*, March, Washington, DC.

Spengler, M., Gottschling, J., Hahn, E., Tucker-Drob, E.M., Harzer, C., and Spinath, F.M. (2018). Does the heritability of cognitive abilities vary as a function of parental education? Evidence from a German twin sample. *Plos one* 13(5): e0196597.

Stanworth, M. (1983). *Gender and Schooling: a study of sexual divisions in the classroom*, London: Women's Research and Resources Centre.

Steedman, J. (1983). Examination Results In Selective and Non-Selective Schools. *National*

Children's Bureau.

Stevenson, J. and Baker, S. (2018). *Refugees in higher education: Debate, discourse and practice*. Emerald Publishing Limited.

Sui-Chu, Esther H., and Douglas J. Willms. (1996). Effects of parental involvement on eighth-grade achievement. *Sociology of education* 69(2): 126-141.

Szreter, S.R. (1984). The genesis of the Registrar-General's social classification of occupations. *British Journal of Sociology(35,4):* 522-546.

Taylor, J., Roehrig, A., Hensler, S.B., McDonald C., and Schatschneider, C. (2010). Teacher quality moderates the genetic effects on early reading. *Science* 328.5977: 512-514.

Taylor, R.D., Oberle, E., Durlak, J.A., and Weissberg, R. (2017). Promoting Positive Youth Development through School-Based Social and Emotional Learning Interventions: A Meta-Analysis of Follow-Up Effects. *Child Development* 88(4): 1156–1171.

The Economist. (2020). Why Britain is more geographically unequal than any other rich country. Retrieved at: https://www.economist.com/britain/2020/07/30/why-britain-is-more-geographically-unequal-than-any-other-rich-country

Tomaskovic-Devey, D. and Avent-Holt, D. (2019). *Relational inequalities: An organizational approach*. Oxford University Press, USA.

Townsend, P., Phillimore, P. and Beattie, A. (1988). *Health and deprivation: inequality and the* North. Routledge.

Trejo, S. and Domingue, B.W. (2019). Genetic Nature or Genetic Nurture? Quantifying Bias in Analyses Using Polygenic Scores. *BioRxiv*.

Trejo, S., Belsky, D.W., Boardman, J.D., Freese, J., Mullan Harris, K., Herd, P., Sicinski, K., and Domingue, B.W. (2018). Schools as moderators of genetic associations with life course attainments: evidence from the WLS and Add Heath. *Sociological science* 5: 513-540.

Tropf, F.C., Hong L., Verweij, R.M., Stulp, G., Van Der Most, P.J., De Vlaming, R., Bakshi, A. et al. (2017) Hidden heritability due to heterogeneity across seven populations. *Nature human behaviour* 1, no. 10: 757-765.

Tucker-Drob, E. M., and Bates, T.C. (2016). Large cross-national differences in gene× socioeconomic status interaction on intelligence. *Psychological science* 27(2): 138-149.

UK2070. (2019) Fairer and stronger: Rebalancing the UK economy - The first report of the UK2070 Commission. London, UK: UK2070.

University of London, Institute of Education, Centre for Longitudinal Studies. (2022). National Child Development Study: Sweeps 3-9, 1974-2013, Townsend Index (LSOA) Linked Data: Secure Access. [data collection]. UK Data Service. SN: 8085, DOI: 10.5255/UKDA-SN-8085-1

Valiente, C., Lemery-Chalfant, K., and Swanson, J. (2010). Prediction of kindergartners' academic achievement from their effortful control and emotionality: Evidence for direct and moderated relations. *Journal of Educational Psychology*, *102*(3), p.550.

Van Doorn, M., Pop, I., and Wolbers, M.H. (2011). Intergenerational transmission of education across European countries and cohorts. *European Societies*, *13*(1), pp.93-117.

Van Ham, M,, Manley, D. (2009). Social housing allocation, choice and neighbourhood ethnic mix in England. *Journal of Housing and the Built Environment* (24,4): 407-422.

Van Ham, M., and Manley, D. (2012). Neighbourhood effects research at a crossroads. Ten challenges for future research introduction. *Environment and Planning A*, *44*(12), pp.2787-2793.

Van Ham, M., Hedman, L., Manley, D., Coulter, R., and Östh, J. (2014). Intergenerational transmission of neighbourhood poverty: an analysis of neighbourhood histories of individuals. *Transactions of the Institute of British Geographers*, *39*(3), pp.402-417.

Van Kempen, R., and Bolt, G. (2009). Social cohesion, social mix, and urban policies in the Netherlands. *Journal of Housing and the Built Environment* 24(4): 457-475.

Van Poortvliet, M. (2021). Inequality in skills for learning: do gaps in children's socio-emotional development widen over time according to family background?. *Oxford Review of Education*, *47*(4), pp.455-474.

Vartanian, T.P., and Gleason, P.M. (1999). Do neighborhood conditions affect high school dropout and college graduation rates?. *The Journal of Socio-Economics*, *28*(1), pp.21-41.

Vartanian, T.P., and Buck, P.W. (2005). Childhood and adolescent neighborhood effects on adult income: using siblings to examine differences in ordinary least squares and fixed-effect models. *Social Service Review*, *79*(1), pp.60-94.

Vartanian, T.P., Buck, P.W., and Gleason, P. (2007). Intergenerational neighborhood-type mobility: examining differences between blacks and whites. *Housing Studies*, *22*(5), pp.833-856.

Venkatesh, S.A. (2000). *American project: The rise and fall of a modern ghetto*. Harvard University Press.

Verropoulou, G., Joshi, H., and Wiggins, R.D. (2002). Migration, family structure and children's well-being: A multi-level analysis of the second generation of the 1958 Birth Cohort Study. *Children & Society*, *16*(4), pp.219-231.

Visser, K., Bolt, G., Finkenauer, C., Jonker, M., Weinberg, D., and Stevens, G.W. (2021). Neighbourhood deprivation effects on young people's mental health and well-being: A systematic review of the literature. *Social Science & Medicine*, *270*, p.113542.

Yang, J., Hong L.S., Goddard, M.E., and Visscher, P.M. (2011) GCTA: a tool for genome-wide complex trait analysis. *The American Journal of Human Genetics* 88, no. 1,pp. 76-82.

Young, A.I., Benonisdottir, S., Przeworski,M., and Kong, A. (2019). Deconstructing the Sources of Genotype-Phenotype Associations in Humans. *Science* 365(6460):1396–1400.

Warner, B.D., Rountree, P.W. (1997). Local social ties in a community and crime model: questioning the systemic nature of informal social control. *Soc. Prob.* 44(4):520–36

Weinhardt, F. (2014) Social housing, neighborhood quality and student performance. *Journal of Urban Economics* (82): 12-31.

Weinhardt, F. (2010). Moving into the projects: Social housing neighbourhoods and school performance in England. *SERC/Urban and Spatial Programme Discussion Paper*. London: Centre for Economic Performance

Wightman, P. and Danziger, S. (2014). Multi-generational income disadvantage and the educational attainment of young adults. *Research in Social Stratification and Mobility*, *35*, pp.53-69.

World Health Organization, (2001). Skills for Life, Geneva: Pp.8.

Wilson, W. (1987). *The Truly Disadvantaged: The Inner-city, the Underclass, and Public Policy*. Chicago, IL: University of Chicago Press.

Wodtke, G.T., Harding, D.J., and Elwert, F. (2011). Neighborhood effects in temporal perspective: The impact of long-term exposure to concentrated disadvantage on high school graduation. *American sociological review*, *76*(5), pp.713-736.

Wodtke, G.T., Harding, D.J., and Elwert, F. (2016). "Neighborhood Effect Heterogeneity by Family Income and Developmental Period." *American Journal of Sociology* 121(4):1168–1222.

Wodtke, G.T., and Parbst, M. (2017). Neighborhoods, schools, and academic achievement: A formal mediation analysis of contextual effects on reading and mathematics abilities. *Demography*, *54*(5), pp.1653-1676.

Wodtke, G.T., and Almirall, D. (2017) "Estimating moderated causal effects with time-varying treatments and time-varying moderators: Structural nested mean models and regression with residuals." *Sociological Methodology* 47, no. 1: 212-245.

Wodtke, G.T. (2018). Regression-based adjustment for time-varying confounders. *Sociological Methods & Research*, *49*(4), pp.906-946.

Wodtke, G.T., Alaca, Z. and Zhou, X. (2020). Regression-with-residuals estimation of marginal effects: a method of adjusting for treatment-induced confounders that may also be effect modifiers. *Journal of the Royal Statistical Society Series A: Statistics in Society*, *183*(1), pp.311-332.

Wodtke, G.T., Ramaj, S., Schachner, J. (2022). Toxic neighborhoods: the effects of concentrated poverty andenvironmental lead contamination on early childhood development. Demography 59:1275–98

Wodtke, G.T., Yildirim, U., Harding, D.J. and Elwert, F. (2023). Are Neighborhood Effects Explained by Differences in School Quality?. *American Journal of Sociology, 128*(5), pp.1472-1528.

Wolfram, T. and Morris, D. (2023). Conventional twin studies overestimate the environmental differences between families relevant to education attainment. Retrieved June 19th 2023:https://psyarxiv.com/m4eqv/

Zhang, M. and Li, Y. (2019). Family fortunes: The persisting grandparents' effects in contemporary British society. *Social science research*, *77*, pp.179-192.

Zhou, X. and Wodtke, G.T. (2019). A regression-with-residuals method for estimating controlled direct effects. *Political Analysis*, *27*(3), pp.360-369.

Ziefle, A. (2016). Persistent educational advantage across three generations: Empirical evidence for Germany. *Sociological Science*, *3*, pp.1077-1102.

Zill, N., and Peterson, J.L. (1986). Behavior problems index. *Washington, DC: Child Trends*.

Zellner, A. (1962). An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. *Journal of the American Statistical Association* (57,298): 348-368.